A Learner-Centred Game-Design Approach: Impacts on teachers' creativity

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Abstract

This study presents an innovative pedagogical approach where teachers become game designers and engage in creative teaching practices. Within co-design training workshops, 21 Spanish primary and secondary school teachers have developed their own Game-Based Learning (GBL) scenarios, especially tailored to their teaching contexts and students profiles. In total, teachers developed 13 GBL scenarios and put them into practice in teaching contexts. The present paper analyses the impacts of this learner-centred game design approach on teachers' creativity from three different points of view: the GBL design process, the GBL scenario, and the teaching processes at stake.

Keywords

Creativity, Game-Based Learning, Game-design

I. Creativity on the stage

Due to several broad transformations in major industrial economies, the twenty-first century requires schools to foster creativity (Sawyer, 2011). Indeed, the function of education is currently being re-conceptualized as building human capital by equipping youngsters with capacities for creativity and innovation (NACCCE, 1999). Nevertheless, creativity still does not seem to play a central role in the curriculum and learning objectives that teachers are asked to follow in European countries (Ferrari et al., 2009).

There seems to be a consensus view within research in education, that creativity is amenable to teaching (Amabile, 1996, Kaufman & Beghetto, 2009, Lin, 2011). For students to learn how to become creative, teachers need to be creative themselves and to provide learners with an ethos and a culture that values creativity (Craft, 2005). According to the National Advisory on Creative and Cultural Education, teaching creatively refers to teachers using imaginative approaches to make learning more interesting, exciting and effective (NACCCE, 1999).

Game-based Learning (GBL) seems to fulfill these requirements. Indeed, games provide challenging experiences that promote the intrinsic satisfaction of the learners and offer opportunities for authentic learning (Gee, 2007; Mims, 2003).

In the context of the ProActive[1] project - Fostering Teachers' Creativity through Game-Based Learning, this study presents an innovative pedagogical approach where teachers become game designers and engage in creative teaching practices. Within co-design training workshops, 21 Spanish primary and secondary school teachers have developed their own GBL scenarios, especially tailored to their teaching contexts and students profiles. GBL scenarios include educational videogames created by teachers embedded in comprehensive units that consider their context of use in the classroom. To do so, they have used two game editors: <e-Adventure>[2], an open-source software for creating adaptable 2D point-and-click adventure games for educational applications; and EUTOPIA[3], a tool for designing multiplayer educational scenarios in a 3D environment. In total, teachers developed 13 GBL scenarios and put them into practice in teaching contexts.

This paper analyses the impacts of this learner-centred game design approach on teachers' creativity at three different stages: the GBL design process, the GBL scenario, and the teaching and learning processes.

II. Creativity in education

In the past creativity was seen by literature as the preserve of a gifted few, rather than of the many, and it was mainly associated with the domain of arts (NACCCE, 1999). However, the scope has been changing to a view through which all people as capable of creativity from early childhood onward. According to this idea, creative potential can be found in every child (Runco, 2003), and its development depends on the kind of training people receive (Esquivel, 1995). Thus, creativity is amenable to education. Furthermore, creativity in education has moved beyond the field of arts, to argue that it is required in all educational subject areas (Craft, 2005).

Creativity in educational contexts can be seen from two perspectives: the one of the teacher being creative and the one of the students being creative. Indeed, NACCCE (1999) made a distinction between teaching creatively and teaching for creativity. The latter refers to forms of teaching that are intended to develop students' own creative thinking and behaviours. It involves teachers in identifying children's creative strengths and fostering their creativity (Cremin, 2009). This is strongly related to the former, as students' creative abilities are most likely to be developed when the teacher's creative abilities are engaged (NACCCE, 1999).

[1] Lifelong learning Programme, Key Action 3, 2010/2011 – Website: http://www.proactive-project.eu

[2] http://e-adventure.e-ucm.es/

[3] http://www.lanas.unina.it/eutopia/

a. Teaching creativity

Teaching creatively refers to teachers using imaginative approaches to make learning more interesting, exciting and effective. Indeed, teachers can be highly creative in developing materials and approaches that foster children's interests. Sale (2005) provides a simple operational definition of creative teaching: "Creative teaching occurs when a teacher combines existing knowledge in some novel form to get useful results in terms of facilitating student learning". Furthermore, Sawyer (2011) provides a list of behaviors in order to give advice for creative teaching, such as trust and safety (i.e. maintaining a psychologically safe classroom environment), problem finding (i.e. encouraging questions and different responses), encouraging surprise, humor, risk taking and allowing mistakes. Cremin (2009) identified a number of features of a creative pedagogical stance, such as adopting a learner-centred ethos, creating space, time and freedom, implementing multimodal teaching approaches, prompting full engagement, ownership and ongoing reflection, modeling risk taking and enabling children to take risks.

Psychologists distinguish process-oriented creativity and product-oriented creativity (Lin, 2011). The former focuses on the "mental process" involving creative potential to generate new ideas and solutions (Esquivel, 1995).

Different authors (Wallas, 1926, Amabile, 1983, Shneiderman, 2000) describe the creative process as an iterative sequence of steps or stages. Models vary according to the number and characteristics of stages. By examining 19 different models, Howard, Culley and Dekoninck (2008) simplify these stages by making three groupings which represent the major phases of a creative process:

Analysis: This phase consists of defining and setting the problem to develop an understanding of what is required in order to generate an acceptable solution. The individual becomes familiar with the content area by building or recalling relevant domain knowledge, and learning from previous works stored in libraries, on the web, etc. Task motivation has to be high, so the individual has sufficient interest to pursue solving the problem.

Generation: This is the creative phase of the process, during which the individual searches through available pathways, exploring features of the environment that are relevant to the task at hand, in order to generate adapted ideas and responses.

Evaluation: The novel ideas and solutions produced during generation are tested, evaluated and verified regarding their appropriateness and value.

On the other hand, according to Cropley (2001), creativity can be seen as a property of products, which might be a tangible (e.g. documents, works of art, etc.) or intangible (e.g. ideas, strategies, systems) result of the creative process (Cropley, 2001). Based a wide number of studies, Villalba (2008) concludes that there is a commonly accepted view of creativity involving the creation of something new and useful. Novel refers to original work, while appropriate concerns the usefulness of the product towards a certain need.

This paper analyses the impacts of this learner-centred game design approach on teachers' creativity at three different stages: the GBL design process, the GBL scenario, and the teaching and learning processes.

III. Game-Based Learning

GBL represents a good candidate for fostering creative teaching practices. Indeed, the literature shows that games have qualities that can facilitate student learning, such as providing challenging experiences that promote intrinsic satisfaction and offer opportunities for authentic learning (Gee, 2007; Mims, 2003), by enabling learners to freely explore the environment in a risk-free environment (Aldrich, 2005). Furthermore, they have proven to increase personal fulfillment and to lead to higher performance (Blunt, 2007).

However, some barriers to the implementation of GBL in formal learning settings by using commercial off-the-shelf games have been identified (Williamson, 2009), such as the lack of

integration of most games with the current curriculum and assessment framework, and teachers and parents concerns over the content of some games. In this context, games created by educators may be easier to integrate in the official curricula. Easy-to-use game editors allow for not only professionals, but also teachers to design educational games.

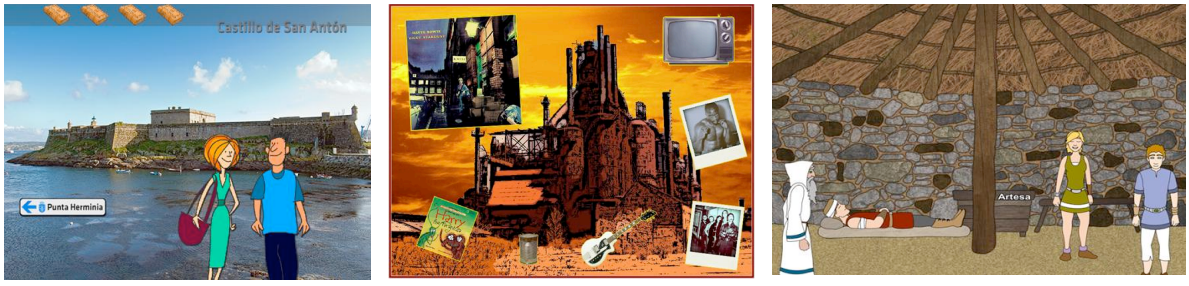
Fullerton (2008) describes the process of game-design with a focus on the player's experience. The author emphasizes the importance of "playtesting" throughout the development process in order to understand the game from the player's perspective, through an iterative, "playcentric" design process. The fact that players are learners adds another dimension to the design, which has not been sufficiently studied in gaming literature.

Game-design processes are reported to promote active learning and foster creativity (Egenfeldt-Nielsen, 2006; Kafai, 1995). However, the corresponding studies refer to the learners / kids as game designers. A literature gap can be observed, regarding the possibilities of game-design by teachers.

IV. The learner-centred game design approach

The study aimed to offer to teachers the possibility to use GBL as an innovative and imaginative approach in their teaching practices. To overcome the obstacles of introducing GBL in formal learning settings, a constructivist approach is adopted, in which teachers designed their own GBL scenarios, specially adapted to students' characteristics. The study was conducted in the following way.

As a first step, a preliminary study was conducted in order to explore teachers' attitude, interests and needs towards GBL and creativity. To do so, two focus-groups were organized by the University of Barcelona research team with 15 teachers from Spanish primary and secondary schools. On the basis of the focus-group outcomes, a training program was designed according to blended learning methodologies, including face-to-face and virtual modalities. During training sessions, 21 teachers from seven primary and secondary schools have been introduced to GBL and have learnt how to use the game editors. On this basis, teachers designed their own GBL scenarios (including digital learning games and complementary educational activities), in an individual or collaborative manner, according to their teaching objectives and their students' profiles. The design process lasted for three months, during which the UB research team provided support to teachers. Support was given through regular meetings and online (Moodle, e-mails, etc.), and was related to pedagogical aspects (definition of learning objectives), game-design strategies (writing of game storyboards, definition of game dynamics and mechanisms) and technical guidance (help on the usage of the game editors). In total, 13 GBL scenarios have been created by teachers, covering a wide range of learning subjects (e.g. History, Physics, and Language Learning) and addressing different educational levels within primary and secondary education.



Picture 1: Screenshots of games created by teachers on History (left and right) and Rock history (middle)

V. Data collection procedures

The study examines creativity through three different aspects, as shown in Figure 1: a) GBL **design**, i.e. when teachers design their educational game and plan a learning scenario; b) the **GBL scenarios**, as the results of the design process; and c) **implementation** of the games in the classroom.

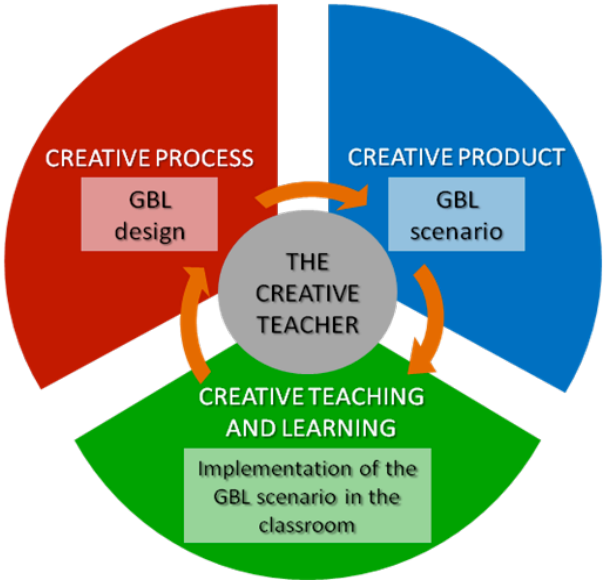


Figure 1: The creative circle of GBL

To evaluate the creative process of GBL design, an open ended questionnaire was designed, aiming to explore the characteristics of teachers' GBL design process within the creative stages identified in the literature. The questionnaire had been validated by recognized experts in the fields of creativity and GBL. It was then filled-in by 16 teachers after the GBL design process.

Based on the literature related to the studying the creativity of a product, our study considers a learning artifact (i.e. the GBL scenario and playable game) to be creative when it is new and appropriate to the teaching contexts at stake. In order to define appropriateness of GBL, a review of successful serious games has been performed[4], which enabled to define a set of key features of good educational games. These features have been grouped into three dimensions, namely *gaming*, *learning* and *technical aspects*. Gaming aspects include consistent rules, balanced challenge, appropriate feedback, immersion, good competition and entertainment. Learning aspects include valuable educational objectives, relevance to students' profiles, appropriate evaluation methodology, personalized learning process and motivation. Finally, technical aspects include ease of use, adapted graphics and reusability in different contexts. A questionnaire was designed, aiming to assess the appropriateness of the designed GBL scenarios according to these three dimensions. It was used by independent GBL experts to evaluate the games and the related scenarios designed by the teachers. Three GBL scenarios have been analyzed at this stage. Furthermore, in order to evaluate the novelty of the creative products, teachers who developed the games were asked if they perceived the GBL scenarios as innovative.

Finally, to explore creativity within the teaching processes, pilot implementation was organized in two Spanish schools in Galicia, a region in the North-West of Spain. During two classroom sessions (one in a primary and another in a secondary school) four games, created with the <e-Adventure> game editor, were tested in secondary school level, and one in primary education. In total, four teachers and 46 students were involved. One teacher performed a pilot implementation with 25 students of fifth year of primary school, age 10 and 11 years old. Three other teachers did so with

4 - The complete literature review is part of an internal deliverable of the ProActive project (ProActive D3.1 - Success factors for GBL) which can be provided upon request.

a group of 21 students from first year of post-compulsory secondary school, age 16.

The games covered various subjects, such as local History and Physical Education. All sessions had similar settings. Each student had a laptop on which s/he played the game. Each game session lasted between 15 and 20 minutes.

In-depth interviews were conducted with teachers and students who participated in the field implementation in the classroom. In addition, observations were performed during the GBL sessions, i.e. two researchers gathered data through participant observation.

Picture 1, Picture 2: Pilot implementation of the GBL sessions in primary school (left) and secondary school (right)

VI. Findings

This section describes the results of the study, exploring creativity in the three evaluation levels, as described previously: the GBL design process, the GBL scenario, and the teaching processes.

a. Dynamics of the GBL design process

The design process has been previously conceptualized according to three different stages, namely analysis, generation, and evaluation. The results of the questionnaire regarding the creative process of GBL design by teachers are summed up below.

During the ***analysis stage***, teachers engaged in the process of GBL design by preparing for the task. Results showed that teachers considered several of the activities as useful.

- *Definition of the task:* Teachers defined their specific teaching objectives (i.e. students' profiles, concepts to be taught, etc.) and became aware of the resources available, i.e. time, material, etc., in order to define the appropriate strategy for teaching and creating an adequate game. Some of them decided to work collaboratively and established work groups.
- *Exploration of the game editors:* During the training workshops, teachers explored the affordances offered by each editor, in order to know what was possible and not possible to do, and develop their game ideas accordingly.
- *Consulting examples of others:* For 13 out of 16 teachers, examples of similar works provided a clear vision of the editors' functionalities and possibilities, as well as an idea of what was possible to create.

On the basis of the analytical phase of definition and preparation, in the ***generation stage*** teachers generated ideas and responses to create their GBL scenarios through several design activities. Results of the questionnaires elicited the following characteristics for each activity.

- *Conceptualization / ideation:* Teachers generated ideas of GBL scenarios according to different factors. First, exploring the affordances of the game editors determined and conditioned their ideas. Second, consulting examples of GBL scenarios created by others helped them to generate ideas and to decide on which editor to choose. It was mentioned

that examples helped teachers understanding what they wanted, and more importantly what they did not want to develop. Teachers who worked collaboratively stated that sharing opinions enhanced the generation of ideas. Finally, in most cases, ideas were determined by external constraints, such as the time they could dedicate to the design process and the editors' limitations.

- *Prototyping:* 14 of 16 teachers felt more confident writing a storyboard for their game, than working directly with the editors. Indeed, answers showed that it enabled them to effectively expand their ideas into the plan of a full consistent game by planning details about the game dynamics, the forms of gameplay, the content of scenes, and the progression of the narrative.
- *Implementation with the editors:* Teachers' ideas were turned into a working game, within a process of development, which was done through the functionalities offered by the editors.

Teachers' ideas, GBL scenarios and games were continuously evaluated and adjusted by teachers through an iterative process (***evaluation stage***).

- *Peer review:* Teachers often involved peers or experts in the evaluation at different moments of the design process. Furthermore, teachers involved their students in order to evaluate the adequacy of their games for the targeted audience.
- *Testing and redesign:* The work with the editors was interwoven with cycles of testing and redesign. Problems or gaps sometimes became apparent, prompting revision. Continuous adjustments of the game elements were necessary before the achievement of a working game.

In some cases, the initial idea was kept and adjusted along the process. On the other hand, most of teachers adapted their game ideas and objectives all along the design process according to two different criteria, feasibility and appropriateness. The former refers to time constraints and editors' affordances. In a teacher's words, "*I had to discard my first idea because the editor did not enable me to easily develop it"*. Teachers generally adapted, and, in many cases, simplified their initial ideas while they learnt how to use the game editor. The latter looks at the value of the GBL scenarios regarding the teaching objectives. In a teacher words, "*my classes and my students were the context in which I always thought to review my game"*. Thus, students' profile and teaching contexts were the core criteria for the ongoing evaluation of the games.

b. Novelty and appropriateness of the GBL scenarios produced

In order to analyze the creativity of the GBL scenarios created by teachers, two aspects were analyzed, i.e. novelty and appropriateness.

Most of teachers considered their GBL scenarios as innovative. Innovation is perceived according to various criteria: the created resources are seen original in comparison from the ones existing on the educational market, which are normally used in similar contexts; furthermore, the games created are new compared to teachers' usual resources. Finally, the experience offered to students is perceived as innovative, as mentioned by one of the teachers: "*the GBL scenario is innovative in comparison to what students usually do with the computer [in the classroom]". Thus, innovation is both p*ersonal (new in respect to teachers' realities) and social (new in respect to the social and cultural environment).

Results of the experts' evaluation suggested that gaming aspects are usually appropriate. Within those, goals, objectives and rules obtained the most positive results. Generally, it was clear what the player has to accomplish and how in order to complete the game. In contrast, feedback was well considered to a certain extent. Most games allow the player to perceive the impact and consequences of his / her actions on the game world. However, all experts believe that it can be enhanced. As an example, one expert stated that "*the impact of incorrect answers is not clear"* and another noted that "s*ometimes, characters make actions without feedback"*.

Other items within the gaming aspects dimension obtained lower scores, such as challenge, immersion, adaptability, replayability, promotion of "good" competition, and entertainment. As an example, replayability can be improved in the games and scenarios that were evaluated. Indeed, one expert stated that the game evaluated is not replayable, as the narrative has only one path.

Overall, learning aspects were more positively evaluated than gaming ones. In general, experts considered that the learning objectives in the games can be achieved "*easily"* and "*satisfactorily"* by the target audiences. In addition, games include sufficient resources to successfully achieve the learning goals. In contrast, experts considered that the evaluation methodology should be given more importance.

As for the technical aspects, usability concerns regarding the use of icons and frequent interactions have been expressed. For instance, an expert evaluator observed that "*when the player has to leave a scene of the game, it could be useful to show where the area to mark on the screen is".* Another evaluator suggested enhancing usability with "*tutorials, menus and showing how to play correctly"*. Graphics and the possibility to use the game in different contexts have been considered average. Some of the improvements suggested by the evaluators are already "in plan" by teachers. It seems important to note that evaluators, as experts in the field, are used to play professionally designed games, with a high level of graphics details. However, these games are still away from the standards of commercial games as design contexts (budget, time, teachers' experience in games, etc.) are not equal.

c. Creative teaching through GBL

Generally, teachers were able to create a psychologically safe classroom environment. Most of the time, teachers acted as facilitators, by checking whether students were finding their way through the GBL activity, and providing guidance, which did not precluded a high level of autonomy of students, who freely interacted with the game and explored its different scenes. Teachers encouraged questions and different responses when they gave feedback to students within the game session. They included humorous elements in their games (jokes, references to elements specific to the students' socio-cultural contexts, etc.). Most students positively reacted to these elements, by smiling, laughing or sharing them with their peers.

Classroom settings included students playing the game individually, or working in pairs. Situations of collaboration among students and teachers were observed, in which they identified and solved problems together. Furthermore, collaboration among students, when working individually, was frequent: when they did not know what to do within the game, they usually asked for help to other peers. Sometimes, learners engaged in short discussions, to arrive at an agreement before deciding what to do.

Moreover, both teachers and students stated that the learning outcomes of the GBL activity were achieved more effectively than with current methodologies. Indeed, the game activity was considered more engaging. As one teacher puts it, "*it was more fun for the students to learn with the game, as it was engaging and the contents will stay in their minds".* About their own learning, students report: "*I have the impression that I am more attentive when using the game. The information is easier to remember"*. In addition, several students stated that games enabled them to "*learn without realizing it*".

VII. Conclusions

This paper explored a methodology through which teachers designed and implemented learning games adapted to their specific educational contexts. Teachers were neither professional game designers, nor experienced in using games in their teaching practices. Creativity was closely looked at during the whole process of GBL design and implementation, although it appeared as an elusive concept, difficult to apprehend.

The process of designing a learning scenario and creating an ad-hoc game was influenced by different factors. A very important one was time. Time conditioned the design, since teachers were compelled to a complex process of adapting and discarding their teaching strategies according to the time available, which was limited. Indeed, a creative process implies time for mastering the support tool, as well as for reviewing and increase the quality of the produced outcome, through an iterative process.

Second, collaboration among teachers appeared as a key-factor to creativity. Sharing opinions among the teachers enhanced the processes of generating and testing ideas. In some cases, this was enriched by involving students in the process, which enabled teachers to evaluate the

adequacy and playability of the games with students, as target audience.

Finally, game editors' affordances appeared to have two roles in the design process. On one hand, as mediators, they shaped the game dynamics, profiling its mechanisms, and facilitating the production of ideas by providing schemes to design the different game elements. On the other hand, they acted as constraints, since scenarios were conditioned by the characteristics of the software.

Teaching processes involving games designed by teachers appeared as a stimulus for teachers and students, both in terms of learning outcomes and motivation for both. Games also supported a creative learning environment, in which questions and humor were encouraged.

The learner-centred game design methodology appeared as a productive and creative approach to teaching and learning, along with difficulties, but worth to explore if we want to promote creative teaching and creative learners and, by extension, creative people. It implied a paradigm change in teachers' practices, who risked their traditional methodologies for unknown teaching approaches, closer to their students' cultural realities.

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