GBL Design for Enhancing Creativity in the Classroom

F. Frossard, M. Barajas, S. Alcaraz-Domínguez, A. Trifonova and J. Quintana

Abstract—This paper presents a study in which a GBL design approach is used to promote creative teaching methodologies. In the context of the ProActive project, 21 Spanish primary and secondary school teachers designed their own educational games, especially tailored to their specific educational contexts, and put them into practice. First results enabled to explore and evaluate creativity at different stages, namely the process of GBL design, the product, i.e. a GBL scenario, and the game-based teaching and learning processes.

Index Terms—Game-Based Learning, Creativity.

I. INTRODUCTION

Creativity has been seen, during the last part of the 20th century and early 21st, to be increasingly significant as a skill to be covered in formal education [1]. Indeed, several authors [2], [3] suggest that creativity should be explicitly included as an educational objective. 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 [4]. Our work aims towards promoting creative teaching and learning in the classroom.

Recent literature makes a distinction between teaching creatively and teaching for creativity [5]. The former refers to teachers using imaginative approaches to make learning more interesting, exciting and effective, which has a direct impact on the latter, as students’ creative abilities are most likely to be developed when the teacher’s creative abilities are engaged.

Creative teaching might be achieved through the use of various imaginative approaches. One of them is Game-Based Learning (GBL). Nowadays, GBL catches the attention of educators at all levels. The Horizon Report [6] states that the “greatest potential of games for learning lies in their ability to foster collaboration, problem-solving, and procedural thinking” (p.5). Literature also 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 [7], [8]. Furthermore, they have proven to increase personal fulfillment and to lead to higher performance (Blunt, 2007). They also support “learning by doing” processes [9], and meaningful learning experiences. In this light, GBL is considered as a powerful teaching method, which can promote creative teaching practices that make learning experience engaging for learners, and improve learning achievements while matching the curricular objectives.

However, some barriers to the implementation of GBL in formal learning settings by using commercial off-the-shelf games have been identified [10], 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 and game editors allow for not only professionals, but also teachers to design educational games.

In this context, the ProActive project aims to engage teachers in a creative process through which they create a plan and the materials for a GBL session that they can carry out in their classrooms. ProActive project allowed practitioners at various educational levels to become game designers by developing GBL scenarios for themselves that have direct relevance to their teaching practices. GBL scenarios for themselves that have direct relevance to their teaching practices. They used two game editors for designing their learning games: <-e-Adventure>, an open source software for creating adaptable 2D point-and-click adventure games for educational applications; and EUTOPIA, a free of charge tool for designing multiplayer educational scenarios in a 3D environment. The GBL scenarios were tested in real settings with students involved in hands on sessions.

The present paper reports the results of the study conducted in Spanish primary and secondary schools. In section II, the ProActive approach towards GBL and creativity is presented. Section III describes the activities carried out with teachers and students. Finally, data collection procedures are explained and first results are exposed.

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II. The **ProActive approach to GBL and creativity**

In this study, GBL design is carried out as a circular process with three stages, as shown in Figure 1. During the creative GBL design stage, teachers design an educational game (stage 1 on the figure). They also plan a learning scenario, which is a more comprehensive unit that considers the context of use of the game. The scenario includes, among other things, the characteristics of the learning audience, the learning objectives, the evaluation approach, and the time-space resources. As a result of the design process, teachers obtain a GBL scenario (see figure 1, stage 2). Then, teachers put into practice the scenario and students experienced it (see figure 1, stage 3). The GBL design process can start again when teachers redesign their GBL scenarios according to feedback from students and the experience.

![Fig. 1. The creative circle of GBL](image)

The following sub-sections provide a short discussion around each of the stages of creativity described above, in order to establish the theoretical framework of the study.

**A. A comparison of models of the creative process**

Different authors describe the creative process as an iterative sequence of steps or stages [11], [12], [13]. Models vary according to the number and characteristics of stages. A comprehensive review of these models can be found in [14]. By examining 19 different models, the authors make 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.

![Fig. 2. Generic Creative Process model (source: [15])]²

² Problem preparation refers to the analysis phase.
Figure 2 illustrates the different phases that are common to the different creative process models.

In this study, we engage teachers in a creative process of GBL design which involves the three phases. In section V-A of this article, we report our first results of the analysis on the creative process.

B. The creative product: effective novelty

According to Cropley [16], creativity is 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. According to Amabile [17], “a product of response will be judged as creative to the extent that it is both a novel and appropriate, useful, correct, or valuable response to the task at hand”. Furthermore, Plucker and Beghetto [18] describe the creative outcome as “a perceptible product that is both novel and useful as defined within a social context”. Based on these and on other studies, Villalba [19] concludes that there is a commonly accepted view of creativity involving the creation of something new and useful. In educational context, NACCCE [20] defines the creative outcome as being original with value that is related to the purpose of the product.

Based on this, our study considers a learning artifact (i.e. the GBL scenario and playable game) to be creative when 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 goals, rules, challenge, feedback, immersion, adaptability, replayability, good competition and entertainment. Learning aspects include educational objectives, students’ profiles, earning resources, evaluation methodology, comprehensive learning scenario, progressive acquisition of knowledge, personalized learning process, autonomy, and motivation. Finally, technical aspects include usability, graphics and reusability in different contexts.

Results from the analysis of the products, i.e. GBL scenarios are provided in section V-B.

C. Creative teaching and learning

As seen in previous work, teaching creatively occurs “when a teacher combines existing knowledge in some novel form to get useful results in terms of facilitating student learning” [21]. Furthermore, Sawyer [22] provides a list of behaviors in order to give advice for creative teaching. We highlight those that are relevant to a GBL session carried out in the context of a classroom. Trust and safety refer to maintaining a psychologically safe classroom environment. Problem finding consists of encouraging questions and different responses. Encouraging surprise, humor, risk taking and allowing mistakes are also recommended. Finally, an inclusive approach must be adopted, where students and teachers collaborate to identify problems and issues.

In our study we look at the implementation of the GBL scenarios in the classroom focusing on these behaviors associated with creative teaching (see sub-section V-C). The goal is to see how the GBL sessions using the games developed by teachers support creative teaching and impact on learning.

III. CONTEXT

The ProActive project started in January, 2010. It involves six partners from four EU countries and covers various educational levels, school education, university level and vocational training. This article concentrates on the pilot implementation carried out in Spanish primary and secondary schools by the University of Barcelona.

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 results, a training program was designed according to blended learning methodologies, including face-to-face and virtual training. Twenty-one teachers from seven primary and secondary schools have been introduced to the ProActive approach and have learnt how to use the game editors. None of the teachers had previous experience with GBL.

Afterwards, an ongoing collaboration process took place during three months, in which the UB research team provided support to the participating teachers in the GBL design process. Support was given through regular meetings (co-design sessions) 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).

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

Fig. 2. Screenshots of games created by teachers on History (left) and soft skills (right)

Pilot implementation was organized in two sites near La Coruña, a city in the North-West of Spain. During two classroom sessions (one in a primary and another in a secondary school) four games were tested in secondary school level, and one in primary education. In total, four teachers and 47 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 a group of 21 students from first year of post-compulsory secondary school, age 16.

All sessions had similar settings. Each student had a laptop on which s/he played the game. Each game session lasted between 10 and 15 minutes.

Fig. 3. Pilot implementation of the GBL sessions in primary school (left) and secondary school (right)

This pilot implementation served as testing the created games and allowed the UB researchers to perform first observations in the classroom. A second, larger scale implementation cycle is ongoing. Final evaluation results are expected by the 2012.

IV. DATA COLLECTION AND PROCEDURES

This section describes the data collection methodology adopted for studying the creativity at different levels: a) the process of the GBL design, b) the GBL scenario created, and c) the game-based teaching and learning processes.

In order to explore creativity in depth, a set of data collection tools was designed and are being used at different stages.

To evaluate the creative process (i.e. stage 1, see figure 1), an open ended questionnaire was designed, aiming to explore the characteristics of teachers' GBL design within the creative stages identified in the literature. The questionnaire had been validated by recognised experts in the field. It was filled-in by 16 teachers after the GBL design process.

Regarding the creative product (stage 2 on fig. 2), a questionnaire was designed, aiming to assess the appropriateness of the designed GBL scenarios according to three dimensions: gaming, learning and technical aspects. It was given to independent GBL experts who evaluated the games and their scenarios. 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 evaluate the creativity of the teaching/learning processes (stage 3 on Fig. 1), in depth interviews were conducted with teachers and students that participated in the field implementation of the GBL scenarios. In addition, observations were performed in order to examine their behaviours during the GBL sessions, i.e. two researchers gathered data through participant observation. The most relevant findings are presented below.

V. RESULTS

This section explores creativity in the three evaluation levels, as described previously: a) the GBL design process, b) the GBL scenario, including the game and the scenario, and c) the teaching and learning processes.
A. The creative process of GBL design

The results of the questionnaire regarding the creative process of GBL design by teachers (stage 1 of Fig. 1) are summed up below.

1) Analysis

During the analysis stage, teachers engaged in the process of GBL design. Furthermore, they prepared for the task by acquiring different types of knowledge and skills. Results showed that teachers considered different 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. Some of them decided to work collaboratively and established work groups.

- **Exploration of the game editors**: This activity started during the training workshops, in which teachers were introduced to the affordances offered by each editor, and continued after the training.

- **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.

2) Generation

On the basis of the analytical phase of definition and preparation, 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**: 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.

3) Evaluation

Teachers’ ideas, GBL scenarios and games were continuously evaluated and adjusted by teachers through an iterative process.

- **Peer review**: Teachers often involved peers or experts in the evaluation at different moments of the design process. Furthermore, in some cases, 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, 11 teachers out of 16 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”. 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.”

B. The creative product, i.e. the GBL scenario created

Following the definition given in section 1:B, to evaluate the creativity of the GBL scenarios created by teachers, two aspects were analysed, i.e. novelty and appropriateness.

1) Perceived novelty

15 out of 16 teachers considered their GBL scenarios as innovative. Some argued that the created resources are different from the ones existing on the educational market, which are normally used in similar contexts. Others
compared them against their usual teaching practices. In a teacher’s words, “the GBL scenario is innovative in comparison to what I saw before, and to what students usually do with the computer”.

2) Appropriateness

Evaluation on appropriateness of the GBL scenarios and games to their contexts of use was performed for the three dimensions mentioned in section II-B, i.e. gaming, learning and technical aspects.

Results suggested that gaming aspects are 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 “sometimes, 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. Learning aspects include the educational objectives, the resources provided to progress through the game, and the evaluation methodology. In general, experts considered that the learning objectives in the games can be achieved “easily” and “satisfactorily”. 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, one observed that “there is no explicit indication that the right button of the mouse must be used to talk to a character”. 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.

C. Game-based teaching and learning processes

Data collected provided insight regarding creative teaching and learning as defined in the framework of the project.

The GBL sessions seem to have been effective considering the educational goals set by teachers in their scenarios, as it was revealed during interviews with students: I learnt how to use the right tools for repairing the bicycle. I learnt new words in Galician. I learnt the names of the trees’ leaves.

Moreover, both teachers and students believe that the learning outcomes of the GBL activity have been achieved more effectively than with the methods they usually use. Indeed, the game activity was considered more motivating. 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 with the game. The information is easier to remember with the game”. In addition, several students stated that games enabled them to “learn without realizing it”.

Some events in the sessions can be related to the creative behaviors as recommended by Sawyer [22]. Generally, teachers worked to maintain a psychologically safe class environment. They spent most of the game session walking around the classroom checking whether students are finding their way through the GBL activity. In this context, a high level of autonomy for learning was achieved.

Educators encouraged questions and different responses when they gave feedback to students within the game session. As an example, one teacher stimulated students by asking “What do you think this image represents?” When necessary, educators played the game on the student’s computer. Teachers appeared confident in their role as facilitators during the sessions.

Teachers included humorous elements in the games they had created such as characters that made jokes. In the GBL sessions, most students participated of them by smiling, laughing or sharing them with their peers. Students between 10 and 11 years old especially enjoyed the humorous elements.

Situations of collaboration among students and teachers were observed, in which they identified and solved technical problems together. Furthermore, collaboration among students was also frequent during all GBL sessions. When a student did not know what to do within the game, he/she usually looked at another student’s. Sometimes, learners engaged in short discussions, to arrive at an agreement before deciding what to do. Alternatively, students gave the right answers to the others or played the game of a partner.
VI. CONCLUSIONS

This paper presented an innovative pedagogical approach in which teachers designed and implemented their own GBL scenarios. Initial results enabled to explore creativity at different levels, i.e. the GBL design process, the GBL scenario and the teaching and learning processes at stake.

Different factors appeared as critical during the GBL design process. First, collaboration positively impacted on this process. Indeed, sharing opinions among teachers enhanced the processes of generation and evaluation of ideas. Furthermore, the involvement of students in the evaluation process enabled teachers to validate the adequacy of their games for the targeted audience. Thus, collaboration acted in the form of inspiration and feedback. Second, time conditioned the GBL design process, as teachers had to adapt (or in some cases discard) their ideas and strategies according to the time available. Finally, game editors’ affordances appeared to have two roles in the design process. On one hand, they acted as mediators, by shaping the game dynamics and profilling its mechanisms, as well as facilitating the production of ideas. On the other hand, they acted as constraints, since scenarios are conditioned by the characteristics of the software.

The GBL scenarios and games were considered as innovative by their authors. Through an expert evaluation, these creative products have proven to be appropriate mostly regarding learning aspects. However, gaming and technical aspects are still away from the standards of commercial games as design contexts (budget, time, teachers’ experience in games, etc.) are not equal.

Regarding teaching and learning processes, the GBL activities have been reported by teachers and students as effective in terms of learning outcomes. They have also supported creative behaviors, such as providing an open educational environment in which questions and humor are encouraged and that supports student-teacher collaboration.

The next steps of the study will consist in a wider implementation in educational settings, which will enable to complement these preliminary results, and to arrive to a comprehensive model of creative GBL, which could be applied to various educational context and sectors.

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