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Abstract. This paper presents a research started in 2010 with the aim of fostering the creativity of teachers through the design of Game-Based Learning scenarios. The research has been carried out involving teachers and trainers in the co-design and implementation of digital games as educational resources. Based on the results gained from the research, this paper highlights successful factors of GBL, as well as constraints and boundaries that the introduction of innovative teaching and learning practices faces within educational settings.

Keywords: Game-Based Learning, educational digital games, learning metaphors, creativity, co-design, user-centered design.

1 Introduction

This paper aims for describing a research that has involved teachers and trainers from various levels (i.e. schools, universities and vocational training within Europe) in a co-design experience to promote an innovative pedagogical approach based on the development of Game-Based Learning (GBL) scenarios.

GBL is nowadays recognized as a valuable approach to education and training. In fact, digital games represent innovative tools to promote active learning and improve students' knowledge and skills, within a context in which entertainment and active participation are stimulated.

Within the research, GBL approach was used in order to foster teachers' creativity, starting from a deep reflection about current teaching and learning practices and the innovative potential of GBL.

The objective of the research was to engage teachers and trainers in co-design sessions for the development of their own GBL scenarios, and to evaluate the impact of the GBL approach on participants' attitudes and practices.

According to the results, this paper suggests several findings which can be considered as useful insights and suggestions in order to achieve a successful implementation of GBL into educational contexts.

2 Research framework

The research presented in this paper has been designed in order to answer to the need for enhancing creativity in teaching practices, through the introduction of innovative psycho-pedagogical approaches and the implementation of GBL scenarios developed by teachers adopting the user-centered approach.

The research framework that was developed through an extensive literature review represents the State-of-Art that laid the groundwork for the research, exploring the literature gaps and teachers' needs. It was also used during the research as conceptual framework to guide the GBL scenarios design.

2.1 Creativity in educational contexts

The *National Advisory Committee on Creative and Cultural Education* [1] defines creativity as an imaginative activity fashioned so to produce outcomes that are both original and of value.

Commonly, people relate creativity to arts and crafts, and the myth that people are born creative or uncreative is widespread [2]. However, nowadays creativity is recognized and valued as a potential of all individuals, a skill to be learnt that can be applied to different knowledge domains, no longer confined in the arts domain [3].

According to this fundamental consideration, Craft [4, 5] introduced the distinction between "big C" and "little c" creativity.

Big C creativity (BCC) refers to extraordinary accomplishments of unusual people, such as renowned artists, scientists and inventors. Their creative achievements are exemplary and comprise novelty and excellence in their domain, as well as social recognition and valuation.

On the other hand, little c creativity (LCC) is not for an extraordinary few. Rather, it refers to personal creativity as the ability to find new and effective solutions to everyday problems.

The concept of LCC seems particularly suitable for the educational sector, where the goal is to encourage all students (and the teachers too) to achieve their full potential.

Creativity can be encouraged or inhibited [6] and its development depends on the kind of training people receive [7].

But the educational system in many countries does not promote creative teaching and learning processes [8]. Indeed, formal education does not facilitate creative behaviors and skills from students, and learners most often act as recipient of methods, pedagogies and knowledge; while teachers tend to give importance to relevance, competence and the need to avoid mistakes [9].

However, in recent years creativity has been seen to be increasingly significant in education, and it is conceived as an important educational objective in itself: «in today's knowledge societies, one of the key missions of the schools is to educate for creativity» [10 p.49].

According to a large EU level survey of teachers [9], there is a remarkable agreement (over 95% of responses) in the understanding of creativity as an attribute that can be applied to every domain of knowledge and to every school subject, and therefore as a fundamental competence to be developed at school.

Current pedagogical discourses attempt to view learners as the centre of teaching and learning processes, with an active role in the production of knowledge and meaning, democratically bringing their expertise, experiences and ideas into the classroom [11] and thus stimulating also creativity.

Nevertheless, creativity still does not seem to play a central role in the curriculum or learning objectives that teachers are asked to follow in every country [12].

NACCCE [1] made a distinction between “teaching creatively” and “teaching for creativity”. The former 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 learners’ interests and motivate their learning. The latter refers to forms of teaching that are intended to develop students’ own creative thinking and behaviors.

However, there is a close relationship between these two approaches, as «teaching for creativity involves teaching creatively. Young people’s creative abilities are most likely to be developed in an atmosphere in which the teacher’s creative abilities are properly engaged» [1 p.103].

2.2 Five metaphors of learning

Traditionally, teachers and trainers used in their practice a dominant learning paradigm, the instructional, while recent studies show that in normal situations learners combine different metaphors to a lesser or greater degree simultaneously [13, 14].

The five metaphors learning model [15, 16] is a description of different ways of learning in different people. It can be treated as a comprehensive model that comes out by combining some learning models with the theories of change by De Caluwé and Vermaak [17]. The result is a classification of the ways of learning into five groups, each one representing a preference for learning that is not exclusive. In fact, every person is able to use all metaphors, but each one in a different situation.

Table 2. Five metaphors of learning and associate dimensions

Metaphor	Associated dimensions
Acquisition	Objective facts, transmission, knowledge from experts, theories
Participation	Dialogue with others, collaboration, discourse, trust, communities of practice
Discovery	Meaning, deep understanding, inspiration, self regulation, knowledge creation
Imitation	Role models, best practice, real life, implicit learning
Experimentation	Safe environment, practising, attitudes, explicit learning, role playing

Considering each metaphor in particular, it is easy to understand the specific perspective on learning that supports the model, as well as the teaching/learning activities involved.

The most common view of learning is as the *acquisition* of something. Knowledge of the world is considered as an objective truth that can be transmitted from one person to another.

According to the socio-constructivism perspective, learning can be considered as a *participation* process in cultural practices and shared learning activities. Cognition and knowing are distributed among individuals and their environment, in the distributed activities of participation [18].

Considering the *discovery* metaphor, the focus is on the process of knowledge creation, the construction of meanings and the pursuit of newness.

According to the fourth metaphor, the vehicle for learning is the *imitation* of role models and best practices that the learner observes, analyzes and then copies.

The *experimentation* metaphor is not focused on knowledge like the acquisition metaphor, but on skills and expertise to be trained by expert and exercised by learners.

In conclusion, the core idea of the five learning metaphors model is that we don't learn in a sole way, but in different ways that depend on personal aptitudes, on the situation where the learning takes place and on the content to be learnt [13, 14].

This model has been chosen as core psycho-pedagogical model of the research since it offers a comprehensive explanation of possible situated learning experiences. The strength of this model in respect of others [19, 20] is, in fact, the focus on contextualized educational theories rather than on cognitive instructional paradigms.

During the research, the metaphors of learning model served as guidelines for the participants in the creation of GBL scenarios as it raised awareness and promoted the reflection on different learning models and guided the game construction.

2.3 GBL at school

As mentioned above, in order to teach creatively, teachers and trainers should use imaginative approaches that make learning experience interesting and engaging for the learner, as well as improve learning achievements and match the curricular objectives. The innovative approach of GBL is a good candidate to fulfill these requirements.

We can define Game-Based Learning as the use of computer or other digital games as tools that support and enhance the learning experience in a meaningful way. Thus, GBL is a trend which analyses the good characteristics of digital games together with their relation with learning, and proposes strategies and paradigms to take advantage of them for education [21, 22, 23, 24, 25].

The features of digital games that are remarkably aligned to learning are several. [26, 27]. Studies in the field of GBL show that digital games can provide challenging experiences that promote the intrinsic satisfaction of the players, keeping them engaged and motivated [28, 29].

In the GBL perspective, learners can assume the role of players (target end-users of the educational games) as well as the role of designers of educational resources. Contributions about this latter possibility are few, but they highlight the interesting other side of the GBL experience.

The core idea of the studies on children as game designers [30, 31] relies in the possibility of turning learners into producers of knowledge, and letting them interact and play with their own games.

«Designing video games makes it possible for the learner to approach a subject in an active way, thereby constructing a personal representation of knowledge by using physical artifacts» [32 p. 198]. This full experience draws learning into different perspectives, while it allows to a variety of actions and to a more complete understanding of the topic to be learned.

Furthermore, the design activity is extremely complex, especially if we consider that its final outcome is an interactive artifact. In fact, «designing digital contents which responds to users' inputs through a series of rules requires the specification of conditions, consequences and sequences of behavior which is not required in writing texts» [33 p. 562].

While the study of learners as game designers is spreading, a literature gap can be observed regarding the possibilities of game design by teachers. Thus, the research discussed in this paper has been designed and conducted in order to fill this gap, promoting the active involvement of the teachers in the development of educational digital games.

2.4 GBL Design framework

In addition to the psycho-pedagogical framework described in the previous paragraphs, the research has been designed according to some assumptions about the introduction of innovation in real practices and within socio-cultural contexts.

When we deal with the development of pedagogical use of Information and Communication Technologies (ICT), we cannot infer that innovation only refers to the technological aspects of the tools. We certainly deal with a complex activity system that includes actors that use artifacts within specific organizational and socio-cultural contexts.

Gaudin [34] suggests that the potentialities of innovation are not provided by the development of sophisticated tools; the process of change relies on the capability of technical arrangements to suggest innovation to an audience of potential innovators. Thus, the innovation can be considered as the meeting point between technological factors and human actors.

According to Bannon [35], the user cannot be considered as “human factor”, as a passive and de-personalized element of the human-computer interaction (HCI) that can be analyzed in the same manner as the information processing mechanisms of the technology. People are more than information-processing subsystems or physiological systems, they have a set of social and cultural values, goals and beliefs which guide their life and work.

Using the term “human actor” emphasizes the holistic nature of the person acting in the real setting, within the situated context, acting to achieve intelligent and meaningful action [36].

According to this fundamental principle of the HCI perspective, the design framework applied in the research deals with the user-centered design (UCD).

The core idea of this approach is that, in order to reach a successful implementation and provide a positive experience to the user, the ICT solution must be designed according to users' characteristics (needs, goals, skills, preferences etc.) and also considering the specific contexts of use [37].

If the games are designed according to these factors, they can provide a successful experience both in terms of entertainment, motivation and learning outcomes.

Based on this fundamental principle, during the research the GBL scenarios have been developed based to the needs and goals of the teachers as well as of the learners, who are both considered as users of GBL scenarios.

3 Research program

It has been demonstrated that digital games represent a good medium to promote active learning and improve students' knowledge and skills, and there is an increasing number of teachers and trainers who recognize the value of GBL.

However, some barriers to the implementation of GBL in formal learning settings have been identified within a study conducted by BECTA [38, 39, 40] on commercial off-the-shelf games: the lack of integration of most games with the current curriculum and assessment framework; time constraints; technical and logistical issues (cost, licensing, limitations of school computers, technical support); lack of teacher skills; not all learners engage with games and many do not see a link between games and learning; teacher and parent concerns over the content of some games (e-safety).

Considering these issues, the research proposed a program in which teachers and trainers design their own GBL scenarios, developing games for themselves that have direct relevance to their teaching objectives and settings.

The research has involved more than 80 teachers and trainers from 23 educational institutions in four European countries (Spain, UK, Italy and Romania).

The research has been carried out following a specific program including different activities that were conducted and supervised by the researchers.

1) *Focus group*

The research has started with a preliminary exploration of teachers' needs, preferences and common practices through focus groups. The discussion was focused on creativity in teaching and learning practices, and the reflection about the different learning metaphors was encouraged.

2) *Training workshop*

Participants were involved in training workshops to acquire the knowledge and skills needed to design the GBL scenarios, using two game editors: a free of charge 3D virtual environment that allows collaborative interaction among learners (EUTOPIA), and an Open Source framework for implementing 2D user-centered adaptable scenarios (<e-Adventure>).

Teachers were introduced to the affordances offered by the game editors, also consulting examples of GBL scenarios created by others, in order to have a clear vision of the editors' functionalities as well as an idea of what was possible to create.

3) *Co-design sessions*

The design process has started with the conceptualization phase, during which participants generated ideas for their own GBL scenarios considering different factors: teaching objectives and curricula, students' profiles, and the resources available (i.e. time constraints, game editors' features, multimedia resources). During the prototyping phase, teachers' ideas were structured as storyboards and then they were turned into digital games using the game editors, within an iterative process.

The design process was performed through individual face-to-face sessions, group sessions and also through e-learning platforms.

The support given by the researchers was related to pedagogical aspects (definition of learning objectives and metaphors), game design strategies (definition of the storyboard, game dynamics and mechanisms) and technical guidance to find multimedia resources and to use the game editors features.

4) *Pilot test*

The GBL scenarios have been tested in real settings with some groups of students involved in hands-on sessions.

4 Research evaluation

At the end of the project, the impact of the proposed research framework and activities has been evaluated according to the following research questions:

- How do teachers evaluate the GBL design outputs?
- How do teachers experienced the implementation of GBL scenarios?
- What is the impact of the research on teachers' attitudes, beliefs and practices?
- How do the educational settings influence the GBL design and implementation?

According to these research questions, the evaluation of the research is focused both on the outputs and on the process of the GBL approach: the GBL scenarios created by teachers (regarding their gaming, learning and technical aspects), as well as the GBL design as it has been experienced by teachers.

5.1 Data analysis

The data corpus collected during the research includes videotapes of all the research activities (focus groups, training and design sessions, pilot test), in addition to semi-structured interviews conducted with teachers at the end of the project so to investigate their opinions and collect their comments about the research.

For the data analysis, the method of Discourse Analysis have been adopted.

Discourse Analysis «has an analytic commitment to studying discourse as texts and talk in social practices. That is the focus is not on language as an abstract entity [...]. Instead is the medium for interaction: analysis of discourse becomes, then, the analysis of what people do» [41 p.146].

In the perspective of the discursive social psychology, the psycho-social processes (such as attitudes and motivations), which are traditionally considered as “mental” processes, arise from the discourse and interactions among social actors [42].

So, the objective of the data analysis is to provide rich descriptions of the complexity of attitudes, motivations and representations of the participants, as they are co-constructed and shared during the research activities.

Unlike the Conversation Analysis that is focused on the mechanism which regulate the conversation (i.e. turnover), data analysis of this research is focus on the content-related aspects of the communicative interactions, on the semantic repertoires though which meanings and representations are constructed and communicated by the social actors. Thus, the transcriptions of the interactions between researchers and participants (during the focus groups, the training workshops, the co-design sessions and the interviews) have been analyzed so to highlights the contents that represent meaningful answers to the research questions.

5 Discussion of results

The results discussed in this paper are strongly related to the specific framework and methodology of the research, but they can represent insights and useful suggestions for those who want to implement GBL approach within educational settings.

5.1 Outputs of the GBL activity

The outputs of the research activities are 60 GBL scenarios dealing with a wide range of subjects (including physics, history, rock climbing and medical routines) developed by teachers and trainers, which have been evaluated by experts involved in the research.

The GBL scenarios developed by participants present several success factors connected with gaming, learning and technical aspects, which make them good learning tools that can also be used in different educational contexts.

As a general rule, the games are considered well-framed and user-centered: they present specific and defined rules to be followed and goals to be attained by the players; they are adapted to the target users (considering age, course of study, previous knowledge and skills); they fit with the educational objectives and they are included in the wider scenarios that embed learning activities before (such as lessons for acquiring the knowledge needed to play the game) and after the game (such as evaluation session, discussion and reflection about the GBL activity).

Considering the structure and the different elements of the game, experts evaluated the games as tools that can immerse the players and enhance their motivation to employ themselves in the learning activity that constitutes a relevant factor for achieving the educational objectives.

Moreover, the GBL implementation has been reported by teachers as effective in terms of learning outcomes because the games provide an open educational environment in which questions and humor are encouraged.

Despite some challenges faced participants during the research (i.e. lack of time, institutional constraints), the GBL design process was considered as pleasant and challenging, and teachers are usually satisfied with the outcome, which is mostly considered as innovative compared with their usual teaching resources and methods.

An Italian teacher mentioned: *«I think my game is definitely innovative!»,* while a Spanish teacher stated that *«there exist very few teaching resources for this type of content, the game is innovative in comparison to what I have seen before, and to what students usually do with the computer».*

Teachers highly valued the fact of having learnt how to use digital games as learning tools, the chance given by the research to reflect on their teaching practices and improve them through the employment of the GBL activities.

Teachers are willing to be engaged in learning activities to improve their work nevertheless they need an extra effort, but such activities has to be perceived as meaningful and professionally effective [43].

5.2 Impact of GBL approach

The evaluation performed shows that the biggest impact of the research has been in participants' knowledge and beliefs. Teachers and trainers from all countries and educational levels have both developed skills for game design and changed their opinions towards GBL approach.

Some trainers reported that participating in the research has made them reconsider their beliefs about how students learn - meaning not through the unique metaphor of acquisition, but integrating different learning models [13, 14]. Whereas a Spanish teacher declares having *«rethought the learning process of his students»,* a trainer from Romania has realized that *«students are more than information receivers».*

This change in participants' attitudes and beliefs was stimulated by the initial discussion about the five learning metaphors [13, 14], and about innovative tools and strategies that can be used in order to teach creatively.

In many instances, participants reflected about their usual working experience and found that they tend to use different teaching approaches for different purposes, despite some of them not being aware of the exact model and not talking in terms of "metaphors".

During the discussion about teaching practices, the main topic was the traditional teaching method (transferring information to learners who act as passive receivers) against the teaching practices that include alternative ways of learning and the use of several tools. An Italian teacher gave an example of this: *«I get bored explaining, I prefer suggesting problems and motivating the students to find the solutions. I always try to do something different, not transmit notions that the students have to acquire, but sharpen and excite them».*

During the GBL design, most of the teachers took into account the metaphors during the design process, both as a starting point and as criteria for evaluating the work done: *«metaphors were a reference while we were designing, the game emerged from them»; «when designing, we were constantly thinking of the different learning styles: participation, imitation, imitation, etc. We were thinking about them in a continuous way in order to plan the right strategy»* (quotes from Spanish teachers); *«the role of*

the metaphors was very important, because we referred to them for starting the game design process» (quote from an Italian teacher); *«I discover that if I take into consideration the learning metaphors, my game will be much valuable and unexpected results will arise»* (quote from a Romanian teacher).

In addition to the impact on participants' attitudes, the GBL design has challenged participants' skills; they appreciate having learnt how to use the game editors and having collaborated with their colleagues.

In other words, having participated in the research seems to have succeeded in introducing educators to GBL as a teaching methodology, as they can now explain what they have learnt and outline what they would do differently if they were to do it again.

5.3 GBL at school: resources and constraints

According to the results of the research, different factors appeared as critical during the GBL design process [43].

First of all, motivation appeared as a critical factor to keep teachers engaged in the game design process that requires time and effort.

Some teachers were personally interested in games per-se and enjoyed designing their own (intrinsic motivation [44]), as pointed out by the following quotes: *«I have always liked to play videogames, I was excited to create my own»* (a Spanish primary school teacher), *«I immediately get involved in the project because I like creating, trying something new and putting myself to the test»* (an Italian primary school teacher).

While the majority of the teachers were highly motivated by the outcome of the process (extrinsic motivation [44]): a new teaching resource useful, engaging and attractive for their students which brings novelty and creativity in their classroom.

Indeed, teachers mentioned that they needed a change in their methodology (*«my course had too much theory»*), a Romanian trainer), as well as resources that *«connect with the curriculum, enrich it, offering another way of learning»* (a Spanish school teacher).

Another factor that has positively impacted the GBL design process is the collaboration: sharing opinions among teachers and also with students enhanced the processes of idea generation as well as the evaluation of GBL scenarios according to target users' characteristics (needs, goals, motivation, skills etc.).

As reported by some participants, the opinion of others helped them in the GBL design process: *«I consulted widely with colleagues and valued their input»* (a trainer from UK) ; *«I can say that my colleagues' opinion helped me to improve my game to be the best»* (a trainer from Romania); *«the project generated, in my school, a sharing climate among teachers, a synergy of team work»*.

Furthermore, teachers highly valued the collaboration with other teachers who share the same motivations and methodologies: *«I felt recognized»*.

During GBL design, such collaboration among participants should be fostered [45, 46], as a Romanian trainer said: *«(it is necessary to) encourage cooperation between trainers, thus creating a community of practices»*.

Beside the supporting factors, the attempt to introduce innovative practices at school faced some challenges related to technical constraints as well as to organizational boundaries. These constraints conditioned the design process, as teachers had to adapt and re-structure their ideas and strategies according to the feasibility.

Considering the game editors' affordances, they have influenced the design process in two ways: they served as mediator by facilitating idea generation and shaping the game dynamics, while they provide constraints based on their software characteristics.

The following quotes highlight this balance of resources and constraints: *«according to the time available, I adapted the game that I wanted to create»* (a Spanish university teacher); *«(I choose to develop) the most feasible idea»* (a Romanian trainer); *«I changed my idea as it was too difficult to implement»* (a Spanish teacher); *«I played around with the idea, but this happened because of the editor's features, which did not allow me to follow a specific path»* (a Romanian trainer).

The organizational boundaries are related not only to the time available to experiment innovative practices, but also to the current paradigm that the institution promotes. In fact, some teachers explained that the introduction of innovative practice is perceived as a personal activity that has to be carried out alone, basically during the free-time, and without the support of the institution.

«I am sorry that this initiatives don't go forward with other teachers [...] I think that teachers don't participate to these initiatives because [...] they may consider these as a loss of time [...] it is required an afternoon commitments and there is already an afternoon commitment at school» (an Italian teacher).

The strong motivation toward the improvement of the teaching strategies have supported the participation during the research, despite the lack of support from the institution. When a researcher have provided the certificate of attendance to the research activities, that doesn't provide formative credit for professional update, an Italian teacher have said: *«It doesn't mean, it is worth for me however»*.

6 Conclusion

The objective of the research presented in this paper was to foster teachers' and trainers' creativity involving them in a co-design experience for the development of GBL scenarios following the user-centered approach.

The research was guided by a psycho-pedagogical framework that served as starting point for a deep reflection about current and innovative teaching practices, as well as main reference during the design of the GBL scenarios by teachers.

The core idea is that teaching and learning processes can be supported by different models (acquisition, participation, imitation, discovery and experimentation), according to the learners personal aptitudes, the situation where the learning takes place and the content to be learnt [13, 14]. The learners can't be no longer considered as recipient of methods and knowledge transmitted by the teachers [9]. Knowledge and skills can be acquired in different ways: participating in shared learning activities, co-constructing meanings with others, imitating best practices, also by trials and errors in a safe and enjoyable environment.

GBL approach is the best candidate to improve teaching practices and provide meaningful learning experiences. But the use of games for educational purposes requires some specific consideration.

Since most of the educational digital games available on the market don't fit specific educational curriculum and assessment framework [39], and due to some technical and logistical issues (cost, licensing, limitations of school computers, need for technical support) [47], the games should be user-centered designed. They should be developed based on needs, skills, preferences of the users (both the students and the teachers) and according to the specific educational settings [37].

In fact, during the research the GBL design process has been influenced by some constraints related to the game editors features and to organizational boundaries.

Adopting a GBL methodology is a time consuming task [46], and some teachers have participated in the research during their free-time. Indeed, schools have scheduled commitments for teachers and students that can't be disregarded, especially in certain periods of the school year [43].

In conclusion, the results gained from the research confirm the GBL as innovative and creative practice for teaching and learning, but its implementation could meet several barriers. Thus, GBL scenarios are implemented within educational settings that can support or impede the innovation. For disseminating GBL activities in schools, the institutions should support teachers' motivation and foster the collaboration among teachers and students. Teachers and trainers can act as potential innovators [34] who can re-invent traditional educational practices and foster their teaching potential in a creative way, despite constraints and boundaries, taking advantage from the use of innovative technologies [43].

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