Fostering teachers' creativity through the creation of GBL scenarios

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Tesis doctoral

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À mes parents.

"All people are capable of creative achievement in some area of activity, provided the conditions are right and they have acquired the relevant knowledge and skills. Moreover, a democratic society should provide opportunities for everyone to succeed according to their own strengths and abilities."

(National Advisory Committee on Creative and Cultural Education, 1999)

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Abstract

Social, economic and global changes make it difficult to predict what the future might hold. Creativity is one possible response to these changes. Indeed, creative skills enable students to face the complex nature of life. As a result, creativity has become significant in education, and is regarded as an important objective to be addressed in the curriculum.

Nevertheless, creativity is not always promoted in schools. Rather, there are those who claim that many educational systems hinder creativity. Indeed, institutional pressures often prevent teachers from engaging in creative teaching practices. Furthermore, there is a lack of guidelines for helping teachers to adopt pedagogical strategies that foster creativity. Hence, the need has emerged for teachers to have models and tools for including creativity in their daily practices. In this context, the present study seeks to provide new models for promoting teachers' and learners' creativity. The thesis investigates the potential of Game-Based Learning (GBL) for promoting creative teaching practices.

Indeed, digital games, when applied to educational contexts, can promote creative pedagogies: they have proved to enhance students' intrinsic motivation towards learning; they are interactive systems which promote learning by doing processes; they also provide meaningful learning experiences by simulating highly interactive scenarios where students face real-world problems; finally, they provide risk-free environments which enable learners to explore and experiment.

Literature identifies some barriers to the implementation of digital games in formal educational settings, such as the difficulty to reach a balance between fun and learning, as well as to align games with curriculum requirements. To tackle these obstacles, my research proposes an approach in which teachers create their own learning games, specially designed to reach their specific teaching outcomes.

My study answers the following question: how can teachers' creativity be enhanced by an approach where they design and apply their own learning games? It attempts to contribute to a greater comprehension of the phenomenon of creativity as applied in educational contexts, through a game design approach. It also aims to contribute to bridging the current literature gap regarding the possibilities of educational game design by teachers. Finally, it intends to provide educational practitioners with concrete examples of creative practices, based on innovative approaches in which teachers design their own educational resources.

In the context of a multiple case study, nine Spanish primary and secondary school teachers designed their own learning games, especially tailored to their educational contexts, and applied them with their students. Within four cases, my research investigated teachers' creativity according to three different dimensions: (a) process (the different stages of educational game design); (b) product (the learning games created); and (c) teaching (the practices at stake during the application of the games).

My study proposes and validates the CEGAD model (Creative Educational GAme Design), which represents the different stages of educational game design by teachers, as well as the influences of the personal and environmental components, from the perspective of creativity. Furthermore, results show that many characteristics of creative pedagogies are supported by the game design approach. Finally, the research highlights the opportunities, facilitators and challenges to the approach, proposing new research directions in the field.

Keywords: Creativity, Game-Based Learning, Game design

Resumen

Los cambios sociales y económicos hacen que sea difícil predecir lo que el futuro puede deparar. La creatividad se considera una posible respuesta a estas transformaciones. Las capacidades creativas permiten a los estudiantes enfrentarse a la compleja naturaleza de la vida. La creatividad se ha convertido, así, en un concepto importante en la educación, y se considera como un objetivo importante a abordar en el currículo.

Sin embargo, la creatividad no siempre se promueve en la escuela. Más bien, hay una cierta corriente de opinión sobre el hecho de que el sistema educativo dificulta la creatividad. Las presiones institucionales impiden que los profesores empleen prácticas de enseñanza creativa, y además, no se observan unas directrices claras para ayudar a los profesores a adoptar estrategias pedagógicas que fomenten la creatividad. Por lo tanto, surge la necesidad, para el profesorado, de tener modelos y herramientas para la integración de la creatividad en el aula. En este contexto, la presente investigación tiene como objetivo proporcionar nuevos modelos para el desarrollo de la creatividad del profesorado, y por ende, la del alumnado. La tesis investiga el potencial de las metodologías de aprendizaje basado en juegos para la promoción de prácticas de enseñanza creativa.

En efecto, los videojuegos, cuando se aplican a contextos educativos, pueden promover pedagogías creativas: se ha probado que pueden aumentar la motivación intrínseca de los estudiantes hacia el aprendizaje; constituyen sistemas interactivos que promueven los procesos de aprendizaje activo; también proporcionan experiencias de aprendizaje significativas, facilitando escenarios donde los estudiantes se enfrentan a problemas del mundo real; por último, proporcionan ambientes libres de riesgo que permiten a los estudiantes explorar y experimentar.

La literatura científica identifica algunas barreras para la implementación de los videojuegos en contextos educativos formales, tal como la dificultad para llegar a un equilibrio entre la diversión y el aprendizaje, así como adecuar los juegos a los requisitos curriculares. Para superar estos obstáculos, mi investigación propone un enfoque en el que los profesores crean sus propios videojuegos educativos, especialmente diseñados para alcanzar resultados específicos de aprendizaje.

Mi tesis contesta a la siguiente pregunta de investigación: ¿cómo se promueve la creatividad del profesor a través de un enfoque en el que diseña y aplica su propio videojuego educativo? Pretende contribuir a una mayor comprensión del fenómeno de la creatividad aplicado en contextos educativos, a través del diseño de videojuegos. Asimismo, aporta nuevos conocimientos, poco presentes en la literatura académica actual, sobre el diseño de videojuegos educativos por el profesorado. Por último, proporciona ejemplos innovadores de prácticas creativas a los profesionales de la educación, basados en un enfoque del profesor como diseñador de recursos.

En el contexto de un estudio de casos múltiples, nueve profesores y profesoras de educación primaria y secundaria diseñaron y realizaron sus propios videojuegos educativos adaptados a sus contextos de enseñanza, y los aplicaron con sus alumnos. A través de cuatro casos, la tesis investiga la creatividad de los docentes en función de tres dimensiones distintas: (a) proceso (las diferentes etapas de diseño de videojuegos educativos), (b) producto (los videojuegos educativos creados), y (c) enseñanza (las prácticas de enseñanza durante la aplicación de los videojuegos en el aula).

La tesis propone y valida el modelo CEGAD (*Creative Eduducational GAme Design* - diseño creativo de juegos educativos), que representa las diferentes etapas del diseño de videojuegos educativos por el profesorado, así como las influencias de los componentes personales y del entorno, desde una perspectiva de creatividad. Además, los resultados ponen de manifiesto que el enfoque de diseño de videojuegos educativos potencia pedagogías creativas. Finalmente, la tesis destaca las oportunidades, facilitadores y retos propios de este enfoque, proponiendo nuevas líneas de investigación en este campo.

Palabras clave: Creatividad, Aprendizaje basado en Juegos, Diseño de videojuegos

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Abbreviations

COTS: Commercial Off The Shelf

GBL: Game-Based Learning

ICT: Information and Communication Technologies

LG: Learning Game

SCORM: Sharable Content Object Reference Model

SG: Serious Game

ZPD: Zone of Proximal Development

Chapter 1
Introduction

1. Background

Since the 90's, the concept of creativity has enjoyed a renaissance of interest, both in academic disciplines (e.g. Psychology) and in applied domains like education (Craft, 2005). Indeed, creativity constitutes an effective response to many of the transformations involved in major industrial economies, such as greater competitiveness and the increasing pace of innovation (Sawyer, 2011). Furthermore, creativity is seen as a source of accomplishment and productivity (Esquivel, 1995). As mentioned in the National Advisory Committee on Creative and Cultural Education report (NACCCE, 1999), creativity represents an essential skill to survive and succeed in knowledge-based economies. As a result, the European Union initiated, in 2009, the European Year of Creativity and Innovation, in order "to promote creativity, through lifelong learning, as a driver for innovation and as a key factor for the development of personal, occupational, entrepreneurial and social competences and the well-being of all individuals in society" (European Commission, 2008, p. 117).

The relevance of creativity to economic competitiveness has recently contributed to shaping education policies. Indeed, governments and businesses around the world now recognize that education is key to the future, and can play a significant role to foster the levels of creativity which are required for economic success (Robinson, 2001).

As a result, since the last part of the 20th century, creativity is regarded as a central skill to be covered by formal education (Craft, 2008). The role of education is currently being redefined as building human capital by acquainting students with creative abilities (Craft, 2005; Lin, 2011; NACCCE, 1999). Hence, creativity has been integrated in the educational policies of several western countries, such as the United States of America, United Kingdom, France, Germany and Sweden (Lin, 2011; NACCCE, 1999). Several Asian countries also engaged in this trend, such as China, Japan, South Korea, and Singapore (Lin, 2011). In Spain, administrations also recognize the importance of promoting creativity in education. Indeed, the organic law of education 2/2006[1] mentions the development of creativity as an educational objective. Furthermore, the 2013 projects of the organic law for the improvement of educational quality[2] highlights the need for students to acquire, from early ages, transversal competences including critical thinking, management of diversity and creativity.

However, current formal education systems do not seem to promote creative behaviours and skills (Ferrari, Cachia, & Punie, 2009b; Sawyer, 2006). Indeed, students are usually taught that knowledge is static, so they become experts at consuming knowledge instead of creating it (Sawyer, 2006). As a result, they learn how to solve specific problems, but cannot respond to unexpected and flexible situations which feature our fast-changing society (Resnick, 2007).

Different institutional pressures prevent teachers from engaging in creative teaching practices, such as the overloaded curriculum and the standardized evaluation procedures they have to follow (Sawyer, 2012). Furthermore, there is a lack of guidelines for helping teachers to adopt pedagogical strategies

[1] www.educacion.gob.es/exterior/centros/jacintobenavente/es/pdf/loe/loe.pdf

[2] www.congreso.es/public_oficiales/L10/CONG/BOCG/A/BOCG-10-A-48-1.PDF

that foster creativity (Lin, 2011). Hence, the need has emerged for teachers to have models and tools for integrating creativity in their daily practices.

Is it really possible to teach creativity? What is the concrete place of creativity in formal educational systems, and what is the role of teachers in creative education? Also, what are the key-characteristics of creative pedagogies? Finally, what concrete methodologies can support the application of these pedagogies? These questions, often raised by researchers and practitioners in social sciences and education, are addressed in the present dissertation.

2. Purpose of the research

My study addressed creativity in educational contexts. It sought to provide teachers with new models for promoting learners' creativity and including it in their daily practices. To do so, it analysed the potential of Game-Based Learning (GBL) for promoting creative teaching practices. Indeed, digital games, when applied to educational contexts, can promote many characteristics of creative pedagogies: they have proved to enhance students' intrinsic motivation towards learning, to capture their attention, and to keep them engaged (Gee, 2003, 2007); they are interactive systems which promote learning by doing processes (Aldrich, 2005); they also provide meaningful learning experiences by simulating highly interactive scenarios where students face real-world problems (Gee, 2003); finally, they provide risk-free environments which enable learners to freely explore and experiment (Crawford, 1984; Salen and Zimmerman, 2004; Ke, 2009). Consequently, I chose GBL as a potential pedagogical approach to foster creative teaching practices.

Many authors (Kirriemuir & McFarlane, 2004; Klopfer, Osterweil, & Salen, 2009; Ulicsak & Williamson, 2011) highlight barriers to the adoption of digital games in formal learning settings, such as the difficulty to reach a balance between fun and learning, as well as to align games with curriculum requirements. To tackle these obstacles, several authors (e.g. Moreno-Ger, Burgos, Martinez-Ortiz, Sierra, & Fernandez-Manjon, 2008; Whitton, 2010) highlight the use of games specifically designed for educational purposes, as a way to promote students' entertainment and to meet exactly the pedagogical objectives addressed. Furthermore, involving educators in the game design process allows for the achievement of high educational standards (Torrente, del Blanco, Marchiori, Moreno-Ger, & Fernández-Manjón, 2010). Nevertheless, there is currently a literature gap regarding practices of educational game design by teachers. Consequently, my study proposed an approach in which teachers created their own Learning Games (LGs) to match their specific teaching contexts and objectives.

The purpose of my research was to analyse teachers' creativity during the design and application of their own LGs. In this objective, it addressed the following question:

> *How can teachers' creativity be enhanced by an approach where they design and apply their own LGs?*

In order to analyse teachers' creativity, I looked at the process of game design, the LG created as a product, and the teaching practices at stake during the application of the LGs in the classroom.

My study attempted to create an innovative model for using game design as a creative teaching strategy. It sought to provide a rich description of creativity complex dynamics at stake during the design and application of LGs. Hence, it employed a qualitative research design, implementing a multiple case study, under a constructivist-interpretive paradigm.

3. Relevance

For the educational research community, my study aimed to contribute to a greater comprehension of the phenomenon of creativity as applied to educational contexts. I also intended to take part in the discussion of change and innovation in educational policies. In addition, the research explored the possibilities offered by an approach through which teachers design and apply their own LGs, thus contributing to bridging the current literature gap regarding the possibilities of educational game design by teachers. Hence, the innovative scientific character of the study relates to the exploration and proposal of a new model for integrating GBL approaches as creative teaching and learning practices. As a result, my study proposed and validated the CEGAD (Creative Educational GAme Design) model.

In addition, my study intended to provide educational practitioners with concrete examples of creative practices, based on innovative approaches in which teachers design their own educational resources. Regarding students, it aimed to increase the quality of learning processes and outcomes. Indeed, as stated earlier, GBL practices have the potential to engage learners in ways other tools and approaches cannot, thus facilitating the achievement of educational objectives. Furthermore, GBL addresses, in different ways, the transversal competences needed in the information age, such as self-regulation, learning by doing, information skills, problem-solving strategies and critical thinking (Johnson, Becker, Cummins, Estrada, Freeman, & Ludgate, 2013; McClarty, Orr, Frey, Dolan, Vassileva, & McVay, 2012; Ulicsak & Williamson, 2011).

By examining multiple cases in various school contexts, my research offered a means to better understand the place of school-based game design methodologies and creativity in education.

4. Context

My research has been partly conducted within the context of ProActive[3] - Fostering Teachers' Creativity through Game-Based Learning, a European project which aimed to promote creative pedagogical approaches through educational game design. Teachers and trainers from different educational levels and sectors (primary and secondary education, higher education, and professional training), distributed among 23 pilot sites in four countries (Spain, United Kingdom, Italy and Romania), used two game editors to design their own LGs, i.e. eAdventure[4], an open source software for creating adaptable 2D point-and-click adventure games for educational applications, and

[3] Lifelong Learning Programme, Key Action 3 (2010-2011) - Code: 505469-LLP-1-2009-1-ES-KA3-KA3MP - Coordination: Universitat de Barcelona, Mario Barajas - website: www.proactive-project.eu

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

EUTOPIA[5], a free of charge tool for designing multiplayer educational scenarios in a 3D environment. Furthermore, they applied their games with their students. The project evaluated the impact of the game design approach on teachers' creativity.

As a researcher at the University of Barcelona (within the Research Group Education and Virtual Learning[6]), I have been actively involved in the ProActive project since its first stages. As a co-author of the original proposal and member of the coordination team, I had an important responsibility with the work undertaken in the project. I was involved in its different tasks, including (a) a comparative study of good practices and the establishment of a list of success factors for GBL; (b) the user needs analysis; (c) the development of a pedagogical framework for fostering teachers' creativity; (d) the organization of game design training workshops for teachers; (e) the support and follow up of teachers during the design and implementation of their LGs; (f) the design of the evaluation framework; (g) data collection and analysis; and (h) the elaboration of guidelines for creative GBL practices.

The ProActive project involved many people in different countries. The work reported in my dissertation relies on data in which I was directly involved, and goes beyond the project. Indeed, I deepened my exploration of the creativity phenomenon by closely working with a group of Spanish teachers during the lifetime of ProActive, and following the results for over one year after the project came to an end. In addition, my study focused on primary and secondary education. In consequence, I chose to concentrate on the eAdventure game editor. Indeed, EUTOPIA is suitable for teaching specific skills (i.e. soft skills such as collaborative and negotiation skills) and for professional training target groups. Furthermore, eAdventure editor was previously used successfully in educational contexts (Moreno-Ger, Torrente, Bustamanteb, Fernández-Galaz, Fernández-Manjón, & Comas-Rengifo, 2010). Some of the data which I collected during the project form part of the exploratory study and preliminary survey reported in this dissertation. Nevertheless, the main data collection process took place after the project ended.

In short, I linked the research with my dissertation following the specific recommendations of the funding body, the European Union, which states that, in order to ensure the quality and success of the research, the work should be connected to the accomplishment of one or several dissertation theses. Until now, the work presented here is the only one of its type that has produced a dissertation and received full support of the international partners involved in the original project.

[5] www.ub.edu/euelearning/proactive/joomla/index.php?option=com_content&view=article&id=3&Itemid=9&

[6] Grupo de Enseñanza y Aprendizaje Virtual (GREAV), http://greav.ub.edu

5. Personal interest in the research

When working on the ProActive project, I appreciated the relationship between GBL and creativity in the context of my daily activities, and by being in close collaboration with several experts in the topics. Together with my director, Dr. Mario Barajas, I realized that there was an opportunity for researching, thoroughly, the potential of a game design approach to enhance teachers' creativity. Hence, I decided to deepen the conceptual and theoretical aspects addressed in ProActive, through an extensive research supported by new data.

More generally, I showed a special interest in the topics addressed in this dissertation. As explained earlier, creativity constitutes a key concept for our current and future society. As a psychologist, I was pleased to take the challenge to explore the phenomenon of creativity. Indeed, its different facets make it a complex concept which is interesting to approach. Furthermore, if a lot has been written on creativity, few studies are supported by field applications. It seemed relevant to concretely apply the concept to education, and particularly to teachers, who play a key role in fostering students' creativity. In addition, I was personally committed to contribute to the diffusion of a democratic view of creativity, as opposed to an exclusive perspective which regards it as the preserve of a few extraordinary people. Indeed, I strongly believe that all individuals have a creative potential, which can be put to the service of the community and common good.

Finally, I liked the idea of studying creativity in relation to digital games. Besides my attraction to the topic, as a gamer in the leisure field, I had the opportunity, in the context of my Master's degree, to study the potential of GBL, and to apply it in the context of different professional experiences. The idea of providing teachers with the necessary tools to design their own LGs was very appealing to me.

6. Publications and related activities

In the context of my research, I have conducted different research activities, which I present in the following paragraphs.

First of all, I obtained a grant from the European network of excellence STELLAR, to participate in the GBL 2011 Summer School[7] (Autrans, France, June 26-July 1, 2011). This 7th CNRS Summer School on Technology Enhanced Learning focused on GBL. I presented a poster entitled "Designing Game-Based Learning Scenarios for Enhancing Creativity in the Classroom" (Frossard, 2011).

Second, I have presented my research in different international conferences and journals:

- *Games and Creativity in Education and Training (GACET 2011), Rome (Italy), November 16-17, 2011:* GACET'11 was a refereed scientific conference acting as a forum for scientists, teachers and trainers to present their latest research on games and learning. The focus was on the use of educational games in creative teaching methodologies. I presented the article "GBL Design for Enhancing Creativity in the Classroom" (Frossard, Barajas, Alcaraz-Domìnguez,

[7] http://gbl2011.univ-savoie.fr/

Trifonova, & Quintana, 2011). Furthermore, I was a member of the organizational committee and co-editor of the proceedings (Barajas, Trifonova, Delli Veneri, Frossard, & Mellini, 2011).

- *EDEN Open Classroom 2011, Athens (Greece), October 27-29, 2011:* the conference aimed to bring together individuals and teams from a wide range of technology and education fields, to look into the future of education and to share their visions. An article was presented: "Teachers as Game Designers: Enhancing Innovation and Creativity in the Classroom" (Barajas, Frossard, & Trifonova, 2011).
- *Digital Education Review (DER):* DER is a peer reviewed open access journal. It is designed as a space for dialogue and reflection about the impact of Information and Communication Technologies (ICT) on education and new emergent forms of teaching and learning in digital environments. I presented the article "A Learner-Centred Game-Design Approach: Impacts on Teachers' Creativity" (Frossard, Barajas, & Trifonova, 2012)
- *Virtual Education Seminar (Seminario de Educación Virtual, SEV), Barcelona, January 21-22, 2013:* this seminar focused on learning and education in the digital society. I gave the presentation "Empowering Teachers Creativity through Game Design". A related article will be published in an e-book.

Finally, I published the article "Serious Games, What are the Impacts on Creativity in the Classroom?" in nº 49 (July, 2012) of Argos, a French magazine (Academy of Créteil) devoted to teaching practices related to reading, writing and documentary abilities. The article is available in Annex 1.5.

7. Thesis outline

The dissertation is organized according to the following structure.

Chapter 2 explores the scientific literature regarding the two areas of interest for the conceptual framework of the study, i.e. creativity in education, and GBL. It first explores the dominant perspectives, theories and models of analysis of creativity. Furthermore, it examines several approaches regarding the relation between education and creativity, and establishes a list of key-characteristics of creative pedagogies. Afterwards, the chapter moves towards the review of GBL as a potential approach to creative teaching. It explores the concepts of games and digital games, identifies different approaches to the integration of games in educational settings, as well as the literature related to the design and evaluation of LGs.

Chapter 3 presents the conceptual framework of the study. On the basis of the theoretical approaches that are relevant to the research, and according to the results of an exploratory study conducted with primary and secondary school teachers, it defines a model for creative educational game design specially adapted to teachers. It also identifies the dimensions to be examined in the research, namely process, product and teaching dimensions.

Chapter 4 describes the research outline and the methodological strategies used for its conduct. It identifies the problem, purpose and questions of the study. Furthermore, it presents the research framework, i.e. the use of qualitative methods, the paradigm and the strategy of inquiry chosen, the unit of analysis, the sources of data and the position of the researcher. It also describes the survey instruments and the processes of data collection and analysis. Finally, it outlines validity and reliability issues, as well as ethical considerations.

Chapter 5 outlines the scenario of the research. It describes the five stages of the fieldwork, i.e. the application of the research approach, the preliminary survey (conducted in order to test and refine the data collection strategies), the selection of cases, and the processes of data collection and analysis.

Chapter 6 describes, for each case study, the analysis of data. It consists of a narrative discussion about the different themes established in relation to teachers' creativity within the design and application of their LGs. The discussion is interpretive, and reports multiple perspectives on the phenomenon studied, by providing views of different individuals and sources of information.

Chapter 7 presents the results of the study, through a cross-analysis of the four different cases. It makes sense of data, and outlines the results and findings corresponding to each research dimension, and answers to the research questions posed by the study.

Finally, Chapter 8 draws the conclusions of the study. It reflects on the research approach (i.e. the design and application, by teachers, of their own LGs) by analysing its opportunities, good practices, and challenges. The chapter ends with the limitations of the research, conclusions and future practices.

Figure 1 provides a map of organization of the thesis.

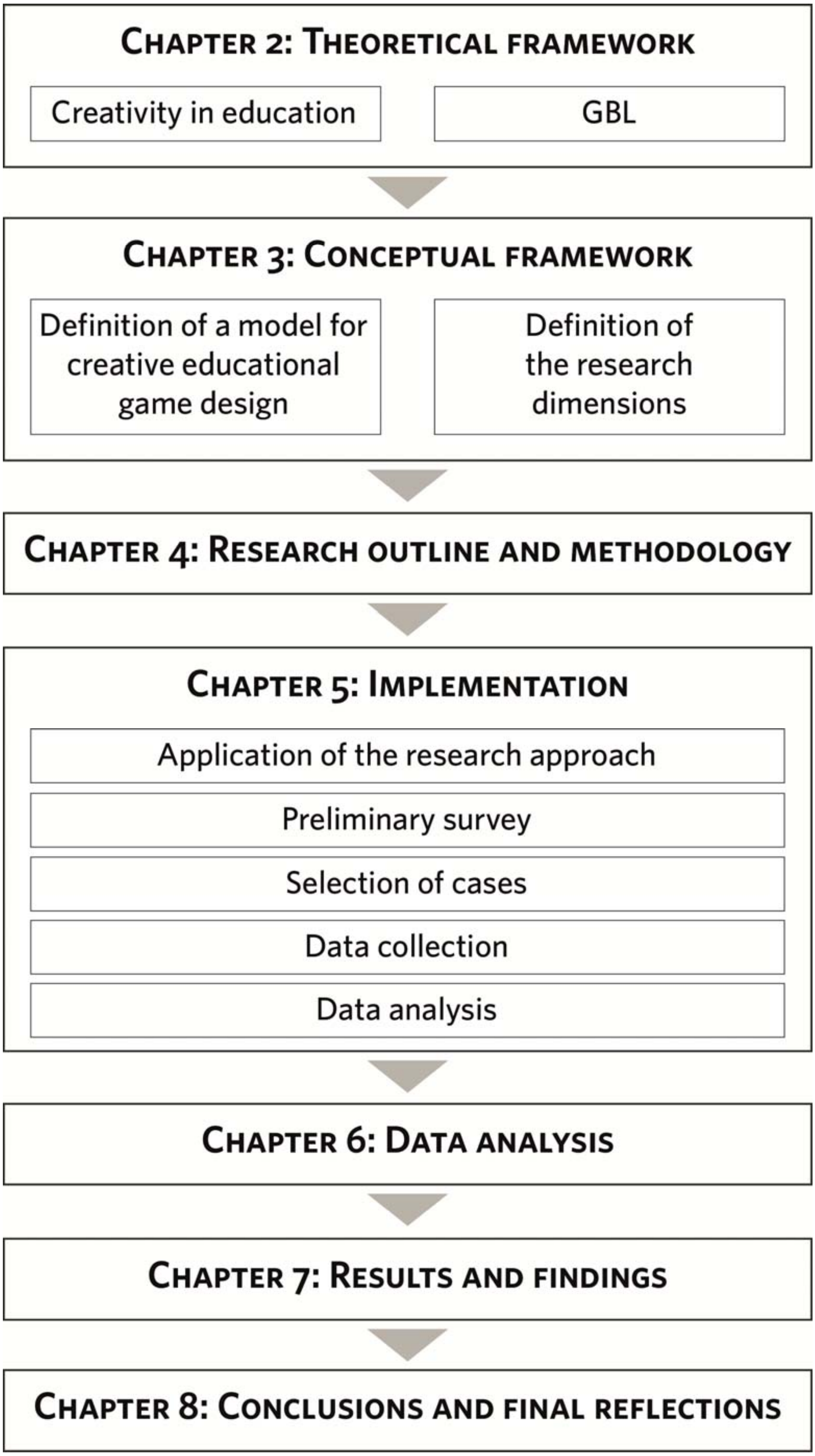

Figure 1: Map of organization of the thesis

Chapter 2

Theoretical framework

Introduction

This chapter identifies, synthesizes and reflects on relevant theories and studies, as well as draws out issues and themes of consideration for the conceptual framework of this thesis. The review covers two substantial areas, i.e. creativity in education, and GBL.

For conducting this thematic review, I considered studies from a range of perspectives, including psychology, education and game studies. However, undertaking a study on creativity and GBL involves examining two immense bodies of relevant literature. Hence, it was necessary to be selective and exclude some areas of research.

The first section of the chapter looks at the dominant concepts and theories of creativity. Due to the overwhelming number of studies and topics of creativity, I concentrated my scope on those more relevant to educational perspectives, thus discarding areas such as intelligence tests and innovations in organizations. Several approaches, assumptions and specific issues are looked at regarding the relation between education and creativity, such as creative teaching and teaching for creativity, in order to establish a list of key-characteristics of creative pedagogical practices.

The second section moves towards the review of GBL as a potential creative teaching methodology. It first tries to understand the concepts of games and digital games, by exploring different disciplines, identifying their main characteristics and discussing their different genres. Afterwards, the section looks at the GBL research field, and examines the potential of digital games to offer creative teaching and learning opportunities. Furthermore, it identifies different approaches to the integration of games in educational settings, and concentrates on the use of games designed for particular educational objectives. Finally, the last part of the review concentrates on the design and evaluation of educational games.

1. Creativity and education

In order to apprehend the place of creativity in education, as well as to identify the teaching strategies which can best foster students' creativity, it is first necessary to define and understand the concept of creativity itself.

As highlighted by several authors (e.g. Amabile & Pillemer, 2012; Sawyer, 2012), creativity is perceived, in the common sense, as a product of individual talents and traits. This rough approach is not appropriate for scientific study. Nevertheless, from the second part of the 20th century, the interest in creativity research started to grow (Sternberg, 2003). As mentioned by Anuska Ferrari, Romina Cachia and Yves Punie (2009b) in a literature review elaborated for the European Commission, creativity is a multi-faceted concept which can be applied to several fields. For example, the American educationalist and psychologist Keith Sawyer (2012) mentions the areas of psychology, anthropology and computer sciences. In order to provide a global understanding of the phenomenon, the next sections attempt to review and resume its conceptions, from different scientific approaches.

1.1. Different approaches to creativity

Due to its complexity, creativity has been approached according to different perspectives. Various paradigms have been studying the concept over time, from unidimensional approaches towards more integrative approaches, which consider several elements simultaneously. Following the different paradigms described by the psychologists Robert Sternberg and Todd Lubart (1999), I present below a brief summary of the history of creativity.

1.1.1. Unidimensional approaches

The first theories on creativity were based on spirituality and mystical approaches, to which a divine being would fill in creative persons with inspiration, so they would generate outstanding ideas and products (Sternberg, 2003). To this view, creativity mainly relates to visual arts, music and writing (Sternberg & Lubart, 1999). The paradigm relies on common assumptions, implicit theories and connotations, but is not amenable to scientific research (Ferrari et al., 2009b).

Later on, the pragmatic paradigm focused on developing methods in order to enhance creativity. Following this objective, several authors (e.g. de Bono and Osborn, as cited in Sternberg & Lubart, 1999) proposed different technics, like brainstorming, for enhancing lateral thinking and problem-solving skills. In spite of their public visibility, these practical approaches were not validated by any empirical attempts (Sternberg, 2003).

The psychodynamic paradigm constituted the first major theoretical approach to the study of creativity. It considered that creativity arises “from the tension between the conscious and unconscious drives” (Sternberg, 2003, p. 92). Indeed, creativity constitutes the expression of the unconscious through a socially acceptable manner (Freud, 1959, as cited in Ferrari et al., 2009b). This approach often relies on case studies of well-known creators (Sternberg & Lubart, 1999). Both its theoretical assumptions and methodological procedures were criticized among the scientific community (Sternberg, 2003).

In contrast to the study of eminent artists, psychometric approaches concentrate on measuring creativity in everyday people through different tests (Sternberg, 2003). The educational researcher Ernesto Villalba (2008) provides an overview of these approaches. The prominent examples are the Torrance Tests of Creative Thinking (Torrance, 1966) which look at divergent thinking and problem-solving skills. If these methodologies allowed for an objective assessment of creativity, they have been widely criticized among the scientific communities. For example, to Amabile and Pillemer (2012), they reinforce the impression that creativity depends on special qualities of unusual persons.

The cognitive paradigm focuses on the internal mental processes at stake while people are engaged in creative processes (Sternberg, 2003). It seeks to understand thinking per se, by looking at internal processes and representations, such as problem-solving, retrieval, association, synthesis, transformation, analogical transfer, and categorical reduction. Cognitive approaches attempt to create models to explain these internal processes (Sternberg, 2003; Sternberg & Lubart, 1999).

Finally, Sternberg and Lubart (1999) describe the evolutionary paradigm, to which creators generate many ideas, and then only select a few. Hence, creative processes involve two steps, i.e. blind variation (ideas are produced without knowing whether they will be successful) and selective retention (where the focus is on choosing which ideas to take forward). These two steps lead to the survival of the most creative possibilities.

If some of these linear approaches have brought some valuable insights to the study of creativity, they do not enable to approach the phenomenon as a whole. Indeed, the situation with creativity research can be described through the fable in which blind men touch different parts of an elephant, but assert that what they touch and perceive is the whole animal (Wehner, Csikszentmihalyi, & Magyari-Beck, 1991, as cited in Sternberg & Lubart, 1999). To tackle this narrowed understanding of the phenomenon, many authors propose multidimensional approaches to creativity.

1.1.2. Multidimensional approaches

Recent studies propose that creativity is found at the convergence of multiple dimensions. Sternberg and Lubart (1999) recommend using multidimensional approaches for studying creativity. The following models are often regarded as valuable contributions.

The educationalist Mel Rhodes (1961) was one of the first authors to argue that creativity is too complex to be investigated as a single entity. By analysing various models among the literature, he determined four distinct dimensions of creativity, and developed, accordingly, a four-component model, known as the four P's of creativity. The four Ps stand for:

- *Process:* the cognitive stages involved in the creation of ideas;
- *Person:* the individual characteristics of the creator(s);
- *Press:* the external environment where creativity happens;
- *Product:* the tangible or intangible result of the creative process.

As highlighted by the author, each of these strands has a unique identity, but they only operate functionally in unity. The four P's model has become a standard framework for research on creativity. Indeed, it helps approaching the different facets of the creativity phenomenon, as well as the interactions among them. Research of these four components is still being conducted (e.g. Runco & Pagnani, 2011).

In addition, the psychologist Teresa Amabile developed the componential model of creativity (1983, 1996), which describes the concept as the confluence of three intra-individual components, i.e. *domain-relevant skills* (expertise, technical skills, and innate talent in the domain of endeavour), *creativity-relevant processes* (cognitive and personality processes which lead to novel thinking, such as openness to experience and persistent work style), and *task motivation* (the intrinsic motivation to engage in an activity, enjoyment, or a personal sense of challenge). Furthermore, the model includes an external component, i.e. the surrounding environment (in particular the social environment), which can influence each of the intra-individual components. The componential theory has been tested, validated and extended in a wide range of studies in the last 25 years (Amabile & Pillemer, 2012).

Additionally, the psychologist Mihaly Csikszentmihalyi (1988, 1996) developed a systems approach, to which creativity results from the interplay between three different elements, i.e. the *domain*, the *individual* and the *field* (see Figure 2). The domain includes a particular set of rules, practices and evaluation criteria. The individual brings a novel variation to the domain, via cognitive processes, personality traits and motivation. This variation is evaluated by the third part of the system, the field, which is composed of various gatekeepers, i.e. experts and scholars who have the rights to choose which variations can be reserved in the domains. Figure 2 illustrates the different components of the systems approach.

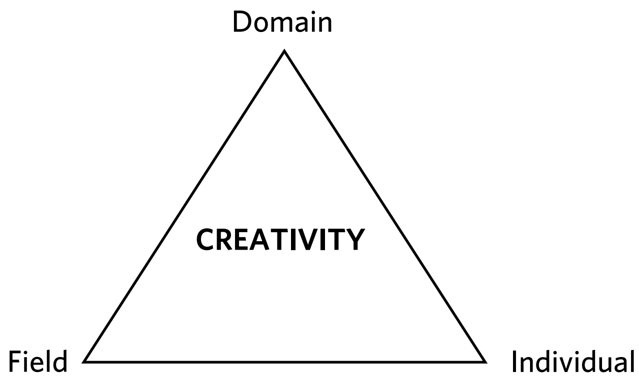

Figure 2: Csikszentmihalyi's creativity triangle. Adapted from Ferrari, Cachia and Punie (2009).

Finally, Sternberg and Lubart (1991, 1995) proposed the investment theory, to which creativity requires six different resources, namely aspects of intelligence, knowledge, cognitive styles, personality, motivation and environment. Furthermore, the model argues that creative people are those who buy low and sell high in the domain of ideas. They pursue unpopular ideas that have growth potential, persist and sell them high.

For the purpose of my research, multidimensional approaches were the most appropriate to explore the different components of creativity. Indeed, my research aimed to explore the complexity of this phenomenon as a system, in order to take into account the various aspects of its implication in educational settings. I detail the way I used these multidimensional models further in this chapter.

1.2. Towards a definition

Defining creativity turns out to be remarkably difficult (Sawyer, 2012), and the lack of a sound definition has complicated the scientific approach of the phenomenon (Sternberg & Lubart, 1999). Indeed, as stated in the NACCCE report, the word has been applied in many different ways and contexts, and by a variety of theories, which makes its definition elusive (NACCCE, 1999).

Among literature in the discipline of psychology (where most of the recent research on creativity has been undertaken in relation to education), there is a consensus on some of the characteristics which define creativity (Villalba, 2008). Indeed, creativity is frequently described as the ability to produce something novel and appropriate (Amabile & Pillemer, 2012; Runco, 2007; Sternberg & Lubart, 1999; Villalba, 2008). Novel refers to an original and unexpected solution, while appropriate concerns the usefulness of the product as regards to a certain need (Sternberg & Lubart, 1999).

NACCCE (1999) provides a similar, but more complete definition. The report describes creativity as an “imaginative activity fashioned so as to produce outcomes that are both original and of value” (NACCCE, 1999, p. 30). Following this definition, creativity processes include four characteristics: (a) they involve thinking imaginatively; (b) they are purposeful (i.e. directed towards a particular objective); (c) they result in an original outcome; and (d) the outcome is appropriate in relation to its specific objective.

In spite of having gained wide acceptance among the scientific community, this conception of creativity has often been criticized. For example, the psychologist Mark Runco (2007) calls these definitions “product bias”, as they consider that creativity involves, in any case, a tangible product.

The educational psychologists Jonathan Plucker, Ronald Beghetto, and Gayle Dow (2004) provide a different definition which does not only concentrate on the product dimension of creativity. To the authors, “creativity is the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as determined within a social context” (p. 90).

This definition puts forward the interaction among different components of the creativity phenomenon, i.e. the process, the environment and the individual. Furthermore, it views the creative product as embedded within a specific social context. For this dissertation, I chose to use this definition, as it corresponds to a multidimensional approach to the study of the phenomenon.

1.3. A model of analysis of creativity

The previous sections enabled to apprehend the concept of creativity through different approaches. Following a multidimensional perspective, my study aimed to explore and understand the interactions between the different components of creativity. To do so, it was necessary to have a model of analysis, in order to effectively embed the research in a meaningful framework.

Rhodes’ categorisation of the different aspects of creativity (Rhodes, 1961) represented a good starting place for my investigation. Indeed, it provides a powerful model of analysis: it offers a useful framework for approaching the complexity of creativity and for exploring my subject and context through the distinct aspects of the phenomenon, in a comprehensive manner. Nevertheless, although I adopted Rhodes’ categorisation, I studied each of the four Ps in the light of more recent literature.

Hence, I explored how the interactions of the different stages of the creative activity (process), the characteristics of individuals (person), the qualities of the environment (press), and the aspects of outcomes of their efforts (product), defined creativity in the particular situation explored in my research.

The next subsections study, in an independent manner, the process, person, press and product components, following recent studies of creativity.

1.3.1. The process dimension

As argued by the psychologist Giselle Esquivel (1995), this dimension refers to the mental processes which lead to the generation of new ideas or solutions to problems. As mentioned by the designers Thomas Howard, Stephen Culley, and Elies Dekoninck (2008), the study of the creative process is described, most of the time, as an iterative sequence of stages. Models vary according to the number and characteristics of stages. The authors provide a comprehensive review of these models was provided. I describe below a number of models of creative processes which are well-known, acknowledged and frequently cited.

Among the first models of creativity, the creativity theorist Graham Wallas (1926) divided the creative process into four different stages: (a) *preparation*, during which the person clarifies the problem and becomes familiar with the content area, by gathering and reviewing internal and external information relevant to the problem; (b) *incubation*, when the person internalises the problem, by processing information in an unconscious manner; (c) *illumination*, when the person experiences an insight by creating a new combination or transformation of ideas; and (d) *verification*, when the person validates the idea in regard to reality. In spite of its antiquity, this model has proved its relevance through years and in recent works (e.g. Runco, 2004), and is still the most well renowned of all process models (Howard et al., 2008).

Csikszentmihalyi's system approach (Csikszentmihalyi, 1988, 1996) proposed a similar process model to the one of Wallas. It includes the following stages: (a) *preparation*, during which the individual becomes immersed in a set of problematic issues; (b) *incubation*, a mysterious phase where ideas process in an unconscious way; (c) *insight*, when the pieces of the puzzle fall together; (d) *evaluation*, when one decides whether the insight is worth pursuing, and; (e) *elaboration*, which defines the phase of hard work required to validate the insight.

Later on, authors tended to move away from the sudden emergence of ideas suggested by the two above mentioned models, towards a more conscious process of emergence (Howard et al., 2008).

For example, the computer scientist Ben Shneiderman (2000) proposed the *Genex* (generator of excellence) framework, which describes a conscious process of idea generation. The model includes four stages: (a) *collect*, where the person learns from previous works from different sources, such as libraries and the Internet; (b) *create*, when the individual explores, composes and evaluates possible solutions; (c) *donate*, in which the person disseminates the results, and (d) *relate,* an iterative stage which consists of consulting with peers and mentors.

Based on earlier process models (e.g. Wallas, 1926), Amabile (1983, 1996) proposed a sequence of five stages and highlighted the potential influences of different components on each stage of the process:

- *Problem or task identification:* the individual becomes aware of the task to undertake or the problem to solve. Task motivation has an important influence at this stage. Indeed, it defines whether and how the individual will engage in the problem or task at hand. If the level of intrinsic interest in the task is high, this interest will often be sufficient to engage in the creative process. Externally posed problems are less likely to be intrinsically interesting than internally generated ones.

- *Preparation:* the person builds up or reactivates information which is relevant to the task at hand. Domain-relevant skills are determinant at this stage. Indeed, the individual may lack domain-relevant skills and have to learn new skills, which may take a high amount of time. In contrast, the person may already possess the necessary skills and only have to reactivate relevant information.
- *Response generation:* the person generates candidate solutions or response possibilities by searching through available pathways and exploring features of the environment that are relevant to the task. Creativity-relevant processes have an important influence on this stage. Indeed, they determine the number of response possibilities generated. Furthermore, intrinsic motivation can affect the individual's willingness to take risks and openness to attend aspects of the environment.
- *Response validation:* the individual uses domain-relevant skills to evaluate the response possibility regarding both usefulness and novelty criteria.
- *Outcome:* finally, "the response is communicated and the outcome of the process is evaluated" (Amabile & Pillemer, 2012, p. 10). If the result successful (i.e. the solution is novel, appropriate, and is accepted by others) or failure (i.e. there is no progress towards the achievement of the task), the process terminates. In contrast, if individuals observe some progress towards the goal, they may return to the previous stages of the process. In this case, the information gained from the trial is added to their domain-relevant skills.

Figure 3 displays the different stages of Amabile's componential model of creativity, and illustrates the influences of the intra-individual components on each stage mentioned above.

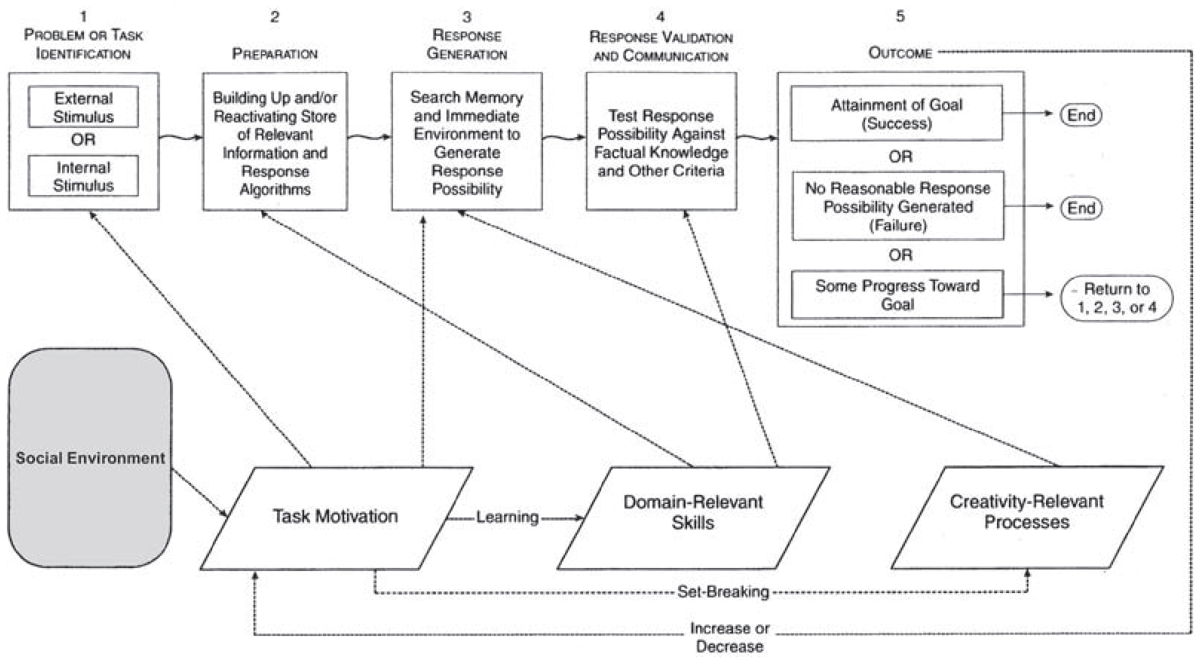

Figure 3: Revision of the componential model of creativity. Reprinted from Amabile (1996)

In this dissertation, I chose to relate to the sequence of stages defined in Amabile's componential model of creativity. Besides of being widely acknowledged in the field of creativity, it studies the creative process according to a multidimensional approach, which considers the influences of the other dimensions of creativity on each stage, in order to make explicit the process of emergence of useful and novel ideas. The application of the model to the context of my study is largely detailed in Chapter 3 (Conceptual framework).

1.3.2. The person dimension

Studies on the creative person concentrate on the individual characteristics of the creator, and often consist of identifying personality traits of creative persons, through biographical and historiometric approaches (Villalba, 2008). I chose not to focus on these approaches. Indeed, concentrating on the presence of traits only leads to identifying creative potential. However, an individual may have a creative potential without using it (Runco & Pagnani, 2011). In contrast, multidimensional approaches consider individual resources as a single component of creativity, and study them through their interaction with other components. The next paragraphs describe the analysis of multidimensional approaches regarding the person dimension.

Sternberg and Lubart's investment theory (1991, 1995)

In their investment theory, the authors argue that creativity occurs in a confluence of interrelated internal resources: intellectual abilities (i.e. creative skill to see problems in new ways, analytic skill to recognize ideas which are worth pursuing, and practical-contextual skill to know how to persuade others of the value of one's ideas), knowledge (i.e. the use of the existing knowledge about a field, without letting it become a hindrance), thinking styles (i.e. preferred ways or decisions about how to deploy one's skills), personality (i.e. attributes such as the willingness to overcome obstacles, to take sensible risks, and to tolerate ambiguity), and motivation (intrinsic, task-focused motivation).

Amabile's componential model (1983, 1996)

As mentioned earlier, Amabile's componential model includes three intra-individual components that influence creativity:

- Domain-relevant skills (corresponding to the knowledge resource in the investment theory) include everything that the individual knows and can do in the particular domain in question, i.e. factual knowledge about the domain, technical skills required to work with ideas and objects in that domain, and special domain-relevant talent.
- Creativity-relevant processes define the personality characteristics, cognitive styles, and work habits that may promote creativity in any domain. They include an appropriate cognitive style (e.g. breaking cognitive set, keeping options open, suspending judgement, using wide categories and tolerating ambiguity), an implicit or explicit knowledge of heuristics for generating novel ideas (e.g. using analogies), and an appropriate work style (including the ability to work during prolonged periods and to abandon unproductive strategies). These elements depend on training, experience in idea generation, and personality characteristics.

- Finally, task motivation determines what the person will do and how it will be done. According to the componential model, people are more creative when they are intrinsically motivated to engage in a task (i.e. when they are mainly motivated by the interest, enjoyment, satisfaction, and challenge of the work itself). Nevertheless, in her revision of the componential model, Amabile (1996) recognizes that some extrinsic motivators (i.e. external pressures or inducements from the social environment), which support competence development and deep involvement in the work, can also enhance creativity.

As mentioned by Amabile and Pillemer (2012), these components "combine in a multiplicative fashion: none can be completely absent, if some level of creativity is to result" (p. 10).

Csikszentmihalyi's systems approach (1988, 1996)

As explained earlier, this approach argues that creativity results from the interactions among three elements, i.e. a domain which contains symbolic rules, an individual who brings novelty to the domain, and a field of gatekeepers who validate the innovation. Additionally, Csikszentmihalyi (1988, 1996) highlighted some traits of creative people, including a genetic predisposition for a given domain, interest in the domain, access to the domain and to the field, complexity, physical energy and concentration, intelligence, convergent (i.e. solving well-defined problems that have one correct answer) and divergent thinking (i.e. generating a great quantity of ideas, switching between several perspectives, and creating unusual associations of ideas), playfulness and discipline, expression of both extroversion and introversion, imagination and fantasy, passion and objectivity.

Furthermore, the author underlines the importance of the motivation element for the person dimension. Indeed, to him, a common characteristic of creative people is *flow* or *optimal experience*, a state of complete engagement in an activity, in which people excel in performance and are so involved with what they are doing that nothing else seems to matter. Hence, the concept of flow directly relates to intrinsic motivation, and is worth to be explored in the context of individual characteristics. Csikszentmihalyi (1990) describes the flow state is as a combination of nine elements:

- *Challenge-skill balance:* when experiencing flow, people have the feeling that their personal skills are at the right level to handle the demands of the activity. At the same time, all their skills are needed in order to handle the challenges of the situation.
- *Action-awareness merging:* people's attention is so much concentrated on the activity, that their actions become spontaneous and automatic. Hence, they stop being aware of themselves as separate from their actions.
- *Clear goals:* the goals of an activity should be clearly defined, so people know what they have to do, can determinate how to get closer to their objective, and develop a feeling of certainty about their actions. However, the goals of some activities are sometimes not clear, as in the case of creative activities (e.g. music composition). In this case, people have to develop a strong personal sense of what they intend to do.
- *Unambiguous feedback:* immediate and clear feedback enables people to know how they are performing towards their goal, and adjust their actions accordingly.

- *Sense of control:* people experience a sense of control over their actions without feeling any fear of losing it. They develop sufficient skills to reduce the margin of error to close to zero, which makes the activity enjoyable.
- *Concentration:* the attention is entirely focused on the task at hand, so no cognitive resources are left for irrelevant information.
- *Loss of self-consciousness:* people lose the sense of their self as separate from the world around it, and become one with the activity. They leave aside everything that is not essential to the activity, including the past and the future. This feeling is sometimes accompanied by a feeling of union with the environment.
- *Transformation of time:* time does not seem to pass the same way it usually does. The rhythms involved by the activity make the actual, external passage of time irrelevant. Time can be seen as passing more quickly, more slowly, or there may be a complete lack of awareness of time passing.

Furthermore, the concept of *autotelic experience* can be regarded as a ninth element (Kiili, 2005). Indeed, as mentioned by Csikszentmihalyi (1990), "the key element of an optimal experience is that it is an end in itself" (p. 67). Hence, the activity is done for its own sake, with no expectation of future reward or benefit, but simply because doing it is rewarding.

The GBL researcher Kristian Kiili (2006) proposed a valuable grouping of the flow elements, which regards the first five ones as "flow antecedents", and the rest as "indicators of flow experience" (p. 189)

In the context of my research, it was pertinent to study the person dimension according to the categorisation of Amabile's componential model (Amabile, 1983, 1996). Indeed, this model enables to study a wide range of individual elements as ordered in three main components, i.e. domain-relevant skills, creativity-relevant processes, and task motivation. Following this categorisation, I considered, as part of creativity-relevant process, some of the individual resources suggested by Sternberg and Lubart (1991, 1995), e.g. willingness to overcome obstacles, to take sensible risks, and to tolerate ambiguity. Furthermore, I considered some of the traits of creative people highlighted by Csikszentmihalyi (1988, 1996), i.e. passion, interest in the domain, access to the domain and to the field. Finally, I took into account the different elements of flow in order study motivation. These choices are further described in Chapter 3 of this dissertation.

1.3.3. The press (environment) dimension

The third component of Rhode's model takes into account the environment in which creativity happens. The term *press* defines pressures that influence creative people or processes. Rhodes (1961) describes it as the relationship between people and their environment.

The power of the environment for fostering or hindering creativity is well documented in creativity literature. In particular, multidimensional theories approach creativity as an interaction between the individual and the outside world. Hence, they argue that creativity is influenced by the environment in which it occurs. For example, Sternberg and Lubart's investment theory describes the environmental context as a resource which contributes to creative performance (Sternberg & Lubart, 1991, 1995). Csikszentmihalyi's systems approach defines creativity as an interaction among individual, product, and environment (Csikszentmihalyi, 1988, 1996). The author highlights several environmental elements that can enhance creativity, including training, expectations, resources, recognition, and reward. Finally, Amabile's componential model includes an external component, the social environment, which exercises an influence on the intra-individual components (Amabile, 1983, 1996).

According to Runco (2004), environmental factors may be either general or specific. General factors include physical surroundings, family upbringing, schooling experiences, cultural traditions, and the historical milieu (Runco & Pagnani, 2011). For example, the authors mention the contrast between views of creativity in Western (which emphasize on novelty and usefulness) and Eastern cultures (which focus on beauty and perfection). Similarly, Simonton (1999, as cited in Amabile & Pillemer, 2012), explored the influences of broad social, cultural, and political factors on famous creative individuals.

In contrast, specific factors refer to interpersonal exchanges or environmental settings (Runco, 2004). For example, Amabile and Gryskiewicz (1989) highlighted different elements of the workplace environment which can enhance creativity, including freedom regarding the strategies available to complete tasks, appropriate resources (facilities, information, time to explore and develop ideas), challenging work, as well as leaders' recognition and support. Furthermore, the authors identified four aspects which can hinder creativity, i.e. time pressure, evaluation, status quo and political problems. Runco (2004) added some potential inhibitors of creativity, such as a lack of respect, constraint, lack of autonomy and resources, inappropriate norms, competition, and unrealistic expectations. However, the author argues that some of these elements are subjective. For example, competition may either stimulate or inhibit creative work, and its impact depends on the individual's interpretation.

Given the context of my research (i.e. small groups of teachers designing their own games using a game editor), I explored the press dimension by looking at the specific factors which were susceptible to directly impact on creativity. First, I studied available resources (i.e. time, technical resources). Second, instead of considering physical environmental settings, I found it more relevant, for the context of my study (i.e. the game design process, which is mediated by digital tools), to focus on the digital environment.

Surprisingly, literature related to the press dimension does not take into account digital environments. However, the affordances of technologies may have a strong influence on creativity. Indeed, as mentioned by the educationalist Avril Loveless (2008), "digital technologies can be tools which afford learners the potential to extend or enhance their abilities, allow users to create novel ways of dealing with tasks which might then change the nature of the activity itself, or provide limitations and structure which influence the nature and boundaries of the activity" (p. 64). Given the context of my research, I aimed to understand the influences of digital environments on the creative processes, individuals and products, as well as to identify whether their affordances helped or limited creativity.

To do so, I explored the affordances of the technology used, usability, as well as its roles in creative processes.

In addition, I looked at the different actors composing teachers' social environment. I accorded a special attention to interpersonal exchanges among creators. Hence, I found it important to focus on collaborative creativity. The following subsections provide theoretical reviews on the topics of collaborative creativity.

Collaborative creativity

As mentioned by the psychologists Arlington Paul Paulus and Bernard Nijstad (2003), traditional approaches of creativity focus on the individual and analyse the creator as a "lone genius". In contrast, numerous studies highlight the social aspect of creativity (e.g. John-Steiner, 2000; Paulus & Nijstad, 2003; Sawyer, 2003; Sawyer & DeZutter, 2009). They argue that creativity often results from collaborations. As argued by Sawyer (2007), "when we collaborate, creativity unfolds across people; the sparks fly faster, and the whole is greater than the sum of its parts" (p. 7). In this line, the psychologist Seana Moran (2010) describes creativity as a collaborative process in which the members of a community produce a useful and novel output for the group at stake, or for a wider community. Furthermore, the psychologist and educationalist Vera John-Steiner (2000) adopts a Vygotskian view, and argues that "generative ideas emerge from joint thinking, from significant conversations, and from sustained, shared struggles" (p. 3).

The educationalists Eteläpelto & Lahti (2008) highlight a series of elements which have been reported to foster or hinder creative collaboration in recent literature. First, trust and security among group members allows for true sharing, long-term relationships, and openly negotiated conflict. Trust defines respect for others and for different perspectives, expectation of good will, mutual care taking and confidence in others' abilities to contribute to the task at hand. It also includes confidence in receiving help in difficult situations (i.e. being provided with emotional and intellectual scaffolding). Second, collaborations benefit from members' complementarity in skills, experience and perspectives (John-Steiner, 2000). Third, a commitment to shared goals enables members to engage in a shared endeavour, or a "joint passionate interest" (John-Steiner, 2000, p. 48). Furthermore, a shared history among group members enhances the establishment of a common culture, a continuity and a customary way of working, as well as enjoyment and positive emotional states (Eteläpelto & Lahti, 2008). Finally, the authors mention tensions as an important factor required to reach outcomes which can handle critical evaluations of alternative views. In contrast, safety is sometimes considered to hinder creativity, while challenge, confusion, perseverance and security loss may foster creative processes (Csikszentmihalyi, 1996). Furthermore, unequal power relationships can affect creativity (Eteläpelto & Lahti, 2008).

In her study of long-term collaborations among famous people along history, John-Steiner (2000) introduced four patterns of partnerships between people engaged in creative work. The first one, *distributed collaboration,* constitutes the most flexible and fragile area of collaboration. On the basis of their similar interests, participants exchange information, thoughts and opinions, in an informal manner. Second, *complementary collaboration* consists of dividing labour among group members, according to their expertise, discipline or personality traits. Roles and relationships are rigid, and may be featured by hierarchy. Third, *family collaboration* is characterized by flexible roles which may evolve over time. Participants are committed to each other for a long time. Finally, *integrative partnerships* result in a transformation of both the field and the participants. They require a prolonged period of time and deep relationships. As mentioned by the author, "they thrive on dialogue, risk taking, and a shared vision. In some cases, the participants construct a common set of beliefs, or ideology, which sustains them in periods of adversity or insecurity" (p. 203). To the author, integrative collaborations are best suited for the emergence of innovation.

In his book *Group Genius* (as opposed to the lone genius of traditional approaches), Sawyer (2007) examined the potential of collaborations by looking at the dynamics of improvisational groups. He extended the concept of flow (Csikszentmihalyi, 1990) to the study of group collaboration. Hence, he brought out the concept of *group flow*, described as "a collective state of mind (…) a peak experience, a group performing at its top level of ability" (p. 43). He also identified several conditions which enable the emergence of this state:

- *Group's goal:* group flow is more likely to occur when the objectives to be achieved are well understood by the group members.
- *Close listening:* focusing on other's discourses and reviewing the relevant information enables to harmonize with team members.
- *Complete concentration:* focusing the attention on the task and on the natural progress emerging from members' work.
- *Control:* group flow can better develop when people feel autonomy, relatedness, competence, control of their actions and their environment.
- *Blending egos:* participants submerge their egos to think with one mind.
- *Equal participation:* participants play an equal role in the creation process.
- *Familiarity:* optimal group experience is more likely to occur if team members know the performance styles of their teammates.
- *Communication:* constant, spontaneous and informal communication.
- *Moving it forward:* extending and building on the ideas of others.
- *Potential for failure:* group flow can be reached more easily when there is the potential for failure.

According the author, group flow is a collective state which cannot be divided into the work of individuals. Rather, it emerges on the basis of group interactions. As argued by the author:

> Group flow happens when many tensions are in perfect balance: between convention and novelty, between structure and improvisation, between the critical, analytic mind and the freewheeling, outside-the-box mind, between listening to the rest of the group and speaking out with your own individual voice. The central paradox of group flow is that it can only happen when there are rules and the participants share tacit understandings, but with too many rules or too much cohesion, the potential for innovation is lost (p. 56).

Considering the aim of my study, I aimed to elicit the conditions for creative collaboration in the specific context studied. To do so, I considered the following aspects of collaboration: complementarity of resources that the individuals bring to the group, in nature of skills and personal qualities, shared history, commitment to common goals. I grouped these aspects in a category called *group members*. Furthermore, I established a second category, *group processes*, which includes the following aspects: relationships among group members, tensions, distribution of tasks and roles among members, equity of participation, communication processes, and power relationships.

1.3.4. The product dimension

As argued by the educational psychologist Arthur Cropley (2001), this approach focuses on creativity as a property of products, which may be either tangible (e.g. documents, works of art, machines, etc.) or intangible (e.g. plans and strategies for solving problems) results of the creative process. The study of product is perceived as highly objective and amenable to the scientific approaches to measure creativity (Runco, 2004). As stated earlier, the scientific community arrived to a consensus regarding the characteristics of creative outcomes, that is, usefulness, novelty, or their synonyms (Howard et al., 2008).

Usefulness

To Howard et al. (2008), it is rather easy to determine the level of usefulness of a product. Indeed, this can be done through testing and evaluation. As mentioned by the authors, "if it works or fits the specification, it is appropriate" (p. 172). Furthermore, examining the usefulness criterion does not consist of a dichotomic evaluation (i.e. correct or wrong). Instead, it consists of *good* rather than *correct*, and *poor*, rather than *wrong* (Warr, 2007, as cited in Howard et al., 2008).

Novelty

In contrast, the novelty criterion is less objective to examine (Howard et al., 2008). Researchers distinguish between different types of novelty. For example, the educationalist Anna Craft (2001) introduced a distinction between *Big-C* and *little-c* creativity. The former refers to outstanding accomplishments of unusual people, which have wider influence in society, as their achievements are novel and recognized in their domain. The latter refers to personal creativity, which enables individuals to "find routes and paths to travel in many aspects of their lives" (p. 46). Furthermore, Moran (2010) introduced *middle-c* creativity, to which the output is considered innovative for an organization or small community of people.

Similarly, NACCCE (1999) argued that creativity involves originality in three possible ways: (a) individual creativity, i.e. originality of a person's work as regard to their previous work; (b) relative creativity, which refers to originality in relation to the creator's peer group; and (c) historic creativity, i.e. originality in terms of anyone's previous output in a particular field.

Evaluation procedures

To Amabile (1983), it is not possible to objectively assess usefulness and novelty. Consequently, assessment methodologies are scarce, and mainly rely on subjective views of the creator or evaluator.

However, few people can judge what is creative (i.e. useful and novel) in a specific context (Howard et al., 2008). Shalley and Gilson (2004, as cited in Howard et al., 2008) argue that a field expert is needed to make this judgement. Similarly, Csikszentmihalyi (1996) considers that usefulness and novelty should be accepted by external people, i.e. the stakeholders of a field, or gatekeepers. For example, in the visual arts, gatekeepers consist of art teachers, curators of museums, collectors of art or critics. They decide what new works must be recognised and conserved.

The product approach tends to conduct to an objective view of creativity. However, it presents several limitations. First, it may be difficult to arrive to a consensus of the creativity of a product, between different evaluators (Cropley, 2001). Indeed, product creativity is a judgment of value. Hence, there is a possibility, for the same product, to be judged creative by one evaluator, but different by another (Csikszentmihalyi, 1996). Thus, not only the creative individual should be considered, but also the evaluators and the criteria for assessing the creative output. In addition, this approach does not go on favour of individuals who have a creative potential, but are not yet expressing it in recognized manners (Runco, 2007), e.g. children and non-professionals.

In this study, I explored product creativity through assessing the usefulness and novelty of the produced outcomes. To do so, I chose to take into account the view of experts in the field of my study. Regarding novelty, I preferred to give more importance to little-c and middle-c creativity, as I am dealing with teachers, who are non-professionals in the field of game design. These decisions are explained in more details in Chapter 3.

1.4. Creativity in educational contexts

The last subsections explored creativity according to various approaches and dimensions. I now concentrate on the study of the phenomenon as applied to the field of education. I first describe the place of creativity in the current educational policies and practices, and then look at the pedagogical strategies which can foster learners' creativity.

1.4.1. Setting the context: policies and practices

Life in the 21st century is featured by a decreasing level of certitude. Indeed, social, economic and global changes make it difficult to predict what the future might hold (Beghetto, 2010). Furthermore, due to different social factors, the roles and relationships among individuals are shifting fast, which requires them to make sense of their experiences and to make choices about their own life (Craft, 2005).

In addition, the globalization of the economic activity increased the competitiveness of markets, raising the need to empower the level of educational achievement of their potential labour forces (Craft, 2005). Furthermore, the development of more and more sophisticated technologies brings out shorter product development cycles, which accelerates the pace of innovation and change (Sawyer, 2012).

Creativity as a new trend in educational policies

In this landscape, students need to be better equipped, so that they can face the more and more complex and ill-defined nature of life (Beghetto, 2010). To the author, establishing a common curricular goal of developing creative competences is seen as a way to prepare them. As a result, the development of students' creative potential has become a core aspect in policy initiatives around the world. As highlighted by Craft (2005), "education is being reconstructed and re-conceptualized, to encompass creativity in its curriculum and its pedagogy" (p. 10).

Formal educational systems do not support creativity

Despite of this context background, creativity is not always valued in schools (Ferrari, Cachia, & Punie, 2009a). Rather, Sir Ken Robinson (2006) claims that schools actually kill creativity. Indeed, creativity requires time, interaction, suspension of judgment, and risk-taking; however, such approaches do not fit with the institutional principles of traditional schools (Ferrari et al., 2009b). Furthermore, as argued by the educationalists Teresa Cremin and Jonathan Barnes (2010), schools sometimes let routines, subject boundaries and decontextualized knowledge dominate, to the detriment of pleasure and excitement related to learning; such practices considerably reduce students' capacities for curiosity, inquiry and creativity.

Beghetto (2010) highlights different barriers to creativity in the classroom. I describe some of them in the next paragraphs, in the light of other studies.

Convergent teaching practices

Formal education is characterized by the transmission of factual bits of information (Beghetto, 2010). Such teaching methodologies tend to look for answers that are known before the question is posed, so students do not need to investigate the issue by themselves (Ferrari, et al., 2009b). As a result, learners act as recipient of knowledge.

Furthermore, there are increased pressures on teachers to conform to externally imposed standards (Beghetto, 2010). As a result, they tend to give priority to relevance and attempt to avoid mistakes. They prefer standard answers to unique ones, and regard unexpected students' ideas as disruptive. Such practices dismiss originality and prevent students from taking risks and developing potential creative ideas (Ferrari, et al., 2009b).

Problematic attitudes and beliefs about creativity

Teachers generally equate creativity with originality, non-conformity and impulsivity (Beghetto, 2010). The author highlights a paradox of desirability, through which teachers prefer conforming and considerate characteristics in students, rather than personality traits associated with creativity, such as self-confidence, ambition and passion. Furthermore, the author highlights the "Big-C bias", through which teachers tend to believe that creativity is at the most eminent levels and does not apply to education (Beghetto, 2010, p. 455).

Motivational messages of the classroom

Teachers often use common motivational strategies which can hinder students' creativity (Beghetto, 2010). Indeed, if rewards and competition can have a positive impact on students' results, the excessive use of extrinsic motivators, as well as the comparison to others, can put pressures on them and weaken their abilities for creative expression (Amabile, 1996).

Creativity can be taught

In spite of the lack of creative practices in the current education system, there is a consensus, among the research community, that creativity is amenable to teaching (Amabile, 1996; Craft, 2001; Esquivel, 1995; Lin, 2011). Indeed, current research considers creativity as a developmental construct and a lifelong process (Craft, 2001; Esquivel, 1995; Lin, 2011). As argued by the educational researcher Yu-Sien Lin (2011), "nurturing creativity through education is to support the individual's development in creative qualities to face everyday problem, to support their need for self-actualization, as well as enhance their capacities for future success" (p. 151).

When looking at recent literature related to creativity in education, it is possible to highlight three clear directions, i.e. (a) an inclusive perspective according to which all individuals can be creative; (b) a focus on everyday creativity, which gives importance to students' personal processes; and (c) the belief that creativity can be developed in all school subjects.

Towards an inclusive perspective

Traditional literature often regards creativity as the preserve of geniuses and people gifted with unusual talents (Loveless, 2002; NACCCE, 1999). However, the scope has moved from this exclusive view towards a democratic perspective, to which all individuals have a creative potential (Loveless, 2002), from early childhood and onward (Craft, 2005). Runco and Pagnani (2011) express this vision as follows:

> It is vital that we recognize that creativity can be found both in the people whose paintings are displayed in museums and also in our family members, friends, neighbours, and in our own lives (p. 64).

Within the field of education, this democratic perspective is growing, and argues that all children have a creative potential which can be encouraged or inhibited according to the kind of training received (Ferrari et al., 2009b). As expressed by NACCCE (1999), "all people are capable of creative achievement in some area of activity, provided the conditions are right and they have acquired the relevant knowledge and skills" (p. 29).

Towards a domain-wide approach

Many people assume that creativity is primarily expressed in the arts, e.g. music, dance and literature (NACCCE, 1999). However, this "art bias" (Runco & Pagnani, 2011, p. 64) leads to underestimating the potential of creativity in other areas of everyday life, such as science and technology (Ferrari et al., 2009b; NACCCE, 1999).

Recently, the shift has moved towards a domain-wide approach, to which creativity concerns different knowledge domains and school subjects (Loveless, 2002). For example, the educationalist Saturnino de la Torre (2006a) argues that creativity in education cannot limit its scope to music, arts or body language disciplines. Instead, it should also apply to other disciplines, such as language and sciences. Craft (2005) also highlighted the need and possibility to enhance creativity in different curricular areas. The author provided some practical examples of creative practices in several subjects, such as the use of collaboration strategies in physical education and problem solving methodologies in mathematics.

Towards everyday creativity

Small levels of creativity (i.e. little-c and middle-c) are particularly suitable for the field of education (Ferrari et al., 2009b). Indeed, they give advantage to learners' new and personally meaningful insight, and encourage all students to achieve their full potential in their everyday domains (Ferrari and al., 2009b; Runco, 2003). In addition, creativity, as applied to learning, requires a process-oriented approach, rather than a product approach (Ferrari and al., 2009b). Indeed, learning consists of a process. Furthermore, when looking at creativity in terms of products, children (i.e. students) have few chances of being considered creative when compared to adults (Runco, 2003).

In this dissertation, I adopted a democratic perspective of creativity. Indeed, I consider that creativity is present in each person and can be involved in all fields. This conception is resumed by NACCCE (1999) as follows:

> One which recognizes the potential for creative achievement in all fields of human activity; and the capacity for such achievements in the many and not the few (p. 30).

Furthermore, I consider the importance of little-c and middle-c creativity, which are particularly useful in educational settings. This position is further stated in Chapter 3 of this dissertation.

The role of teachers in creative education

The increasing importance given to creativity in educational research, policy and practices (Craft, 2005) puts teachers as key-players for bringing creative practices into the mainstream curriculum (Beghetto, 2010). Indeed, "no matter how good policies are, they rely on teachers to implement them in classrooms" (Ferrari et al., 2009a, p. 360). Hence, teachers play an important role in fostering students' creativity (Esquivel, 1995). They should accompany them in the process of knowledge building, by adopting roles of facilitator and fellow collaborator (Sawyer, 2012).

However, as mentioned by Sawyer (2012), different institutional pressures prevent teachers from adopting creativity-fostering behaviours. Indeed, they have to cover a large amount of material, and prepare students for standardized pedagogical objectives or assessment procedures which do not consider creativity. This constraint to follow an overloaded curriculum, in a culture of accountability, can limit teachers' opportunities for creative practices (Cremin & Barnes, 2010).

Consequently, Ferrari et al. (2009b) highlight contradictions among educational policies, and outline a gap between policies and practices. Furthermore, the authors argue that schools need support in order to implement policies for creativity in education. Indeed, these initiatives raise little discussions on guidelines for adopting creative teaching practices (Lin, 2011).

The need has emerged for teachers and educators to have models and tools aimed to develop a language for understanding and promoting learners' creativity, and to find ways to relate the curriculum to creativity in their specific areas of knowledge. My research aimed to fulfil these need, and focused on the role of teachers for enhancing creativity in education. The next section explores the conditions which are necessary to promote creative teaching and learning practices.

1.4.2. Creative pedagogies

Literature on creativity in education distinguishes two particular foci, i.e. *teaching for creativity* and *teaching creatively* (Craft, 2005; Jeffrey & Craft, 2004; NACCCE, 1999; Lin, 2011). As mentioned by NACCCE (1999), the former refers to teaching practices which aim to develop students' creative thinking and behaviours. In contrast, the latter takes a teacher orientation. It consists of using imaginative approaches which can make learning more interesting, exciting and effective. Indeed, "teachers can be highly creative in developing materials and approaches that foster children's interests and motivate their learning" (p. 89).

Teaching for creativity

NACCCE (1999) identifies three tasks which are required in order to teach for creativity. The first one is to encourage young people to believe in their creative potential by giving them the confidence to try. Moreover, it is important to encourage pupils to take risks, as well as to be enterprising and persistent when facing adversity and failure. The second task consists of helping young people to discover their own creative strengths and abilities. Finally, teaching for creativity aims to assist students in understanding what is involved in being creative and help them become more sensitive to their own creative processes. In addition, Jeffrey and Craft (2004) highlight a fourth task, i.e. the inclusion of learners in decisions about what knowledge needs to be investigated, how to investigate it and how to evaluate the learning processes. In this learner inclusive approach, teachers and learners engage in a collaborative approach.

In addition, to NACCCE (1999), teaching for creativity aims to encourage students' autonomy (i.e. a feeling of ownership and control over the ideas that are offered to them), authenticity in initiatives and responses (deciding for themselves on the basis of their own judgment), as well as their openness to new, unusual ideas, and to different approaches, respect for each other and fulfilment (i.e. feeling of satisfaction, involvement and enjoyment).

Finally, as mentioned by Craft (2005), teaching for creativity requires educators to be creative themselves, by adopting an ethos and a culture which consider creativity. The next paragraphs centre on this aspect.

Teaching creatively

The NACCCE report defines creative teaching as "using imaginative approaches to make learning more interesting and effective" (NACCCE, 1999, p. 89). There is a wide range of research dedicated to creative teaching practices. As described below, many of them attempt to identify teachers' personal qualities.

De la Torre (2006b) highlights different traits of creative teachers, such as confidence, a positive mind and an aptitude to value the positive in others, openness to learn from the environment and from mistakes, as well as a belief in happiness as an educational goal. Furthermore, the author outlines the different roles of creative teachers, including the creation of learning situations relevant to students' characteristics, the establishment of relationships between already acquired and new knowledge, the contribution to the creation of a positive self-esteem, and the development of critical thinking. The author brings out creative teachers' collaboration spirit, social awareness, aptitude to participate in innovative projects, and defence of values such as tolerance, peace, solidarity and cooperation. In addition, de la Torre (2009) and de la Torre and Violant (2003) add that creative teachers have flexible attitudes towards people, decisions and events, and are open to changes.

By reviewing educational literature, Cremin (2009) identifies various features of personality characteristics of creative teachers, including confidence, curiosity, enthusiasm, commitment, openness to emotions, a sense of the self as a creative being, and secure knowledge about the subject. Creative teachers are also comfortable with risk-taking, and are likely to perceive failure as a learning opportunity. They have a humanist approach and a strong moral investment in their work. Finally, the author highlights a combination of childlike play and exploration with adult-like self-awareness. In addition, Cremin and Barnes (2010) add some features to this list, such as a clear set of personal values, the willingness to be intuitive and introspective, a belief in human rights and equality, a desire for clarity, and respect for others.

While exploring the relationships between teaching for creativity and teaching creatively, Jeffrey and Craft (2004), based on ethnographic data of an infant school, noted that the two approaches are closely related. Indeed, to them, "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" (p. 103). Hence, in spite of their different foci, the two approaches are deeply interconnected (Lin, 2011). Also, as mentioned by Craft (2005):

> This distinction has been useful in highlighting the importance of teaching for creativity, but in making the distinction there is a danger that a new dichotomy becomes institutionalised in educational discourse, similar to those in the past such as formal and informal teaching or instruction and discovery learning (p. 42).

As a result, in the context of my study, I decided to merge both approaches, and to apprehend, more broadly, creative pedagogies, i.e. teaching strategies which foster students' creativity.

A set of key-characteristics of creative pedagogies

Literature highlights a wide range of practices which can enhance teaching for creativity and/or teaching creatively. However, they often result in long lists of characteristics which sometimes overlap. Among recent research, I extracted the most important ones, and organized them into different categories. As a result, I obtained a set of key-characteristics of creative pedagogical practices, i.e. teaching practices which enhance students' creativity.

a) Promoting learner-centred methodologies

Creative pedagogies place learners above the curriculum and employ person-centred teaching practices (Cremin & Barnes, 2010; de la Torre, 1993). To do so, they connect to students' life and interests, in order to make learning relevant and meaningful to their immediate needs and interests (Amabile, 1989). Hence, learning is personalized, individualized and match students' functioning and needs (Ferrari et al., 2009b; Runco, 2003). Furthermore, as mentioned in a survey conducted by the Office for Standards in Education (Ofsted, 2010), creative teaching strategies promote inclusiveness, ensuring that content and methods are accessible and relevant to all students.

b) Allowing for self-learning

Creative pedagogies place students as protagonists and active participants in the classroom (de la Torre, 2009; de la Torre & Violant, 2003). They offer them opportunities to choose their own ways to solve problems (Sawyer, 2012), as well as encourage their ownership, autonomy and independence, so that they learn and think for themselves, not for the teacher (Amabile, 1989; Cremin & Barnes, 2010; Ferrari et al., 2009b; Robinson, 2001). In this context, students are no longer considered as receivers of information. Instead, they develop knowledge, understanding and skills through first-hand, practical experiences (Ofsted, 2010). Learning results in a stimulating, conscious process (de la Torre, 2009; de la Torre & Violant, 2003). As mentioned by de la Torre (1993), creative practices enable to build knowledge with the active involvement of students, from its planning until its internalization.

Hence, to Ferrari et al. (2009b), creative pedagogies relate to constructivist approaches. Indeed, the authors highlight democratic practices, to which everyone has a say, and learners have an active role in the production and negotiation of meaning (Craft, 2005; de la Torre, 2009; de la Torre & Violant, 2003; Runco, 2003; Sawyer, 2012). In this context, teachers pass the decision making and the responsibility for learning back to students (Cremin, Burnard & Craft, 2006; Ferrari et al., 2009b). Hence, they stand back and become coaches (Amabile, 1989), facilitators and fellow collaborators, accompanying students in a process of knowledge building (de la Torre, 2009; de la Torre & Violant, 2003; Sawyer, 2011). Hence, they guide learners without over-directing them (Ofsted, 2010).

c) Helping to make connections

De la Torre (2006a) outlines the problematic of knowledge fragmentation in today's schools, i.e. teachers teach and evaluate their disciplines as islands, isolated from other areas of knowledge. At the contrary, creative pedagogies should facilitate the interrelation between different areas of knowledge, and the understanding of each element of knowledge as part of a wider context.

In addition, creative pedagogies make emotional connections and help students find relevance in their work, by using metaphors, analogy and personal anecdotes (Cremin & Barnes, 2010). Furthermore, connections can be made by opening the doors of the schools to outside influences and the wider community (Cremin, Barnes, & Scoffham, 2009).

Hence, creative pedagogies help students making connections, seeing relationships, building on previous understanding (Ferrari et al., 2009b), imagining other viewpoints and adopting different perspectives (Sawyer, 2012), as well as placing knowledge in a wider context (Cremin & Barnes, 2010). As a result, students can transfer learning and make connections between different domains, think across disciplines, as well as apply knowledge to new topics or contexts (Ferrari et al., 2009b; Sawyer, 2012). As mentioned by Ferrari et al. (2009a), creating a bridge between different domains promotes a holistic approach to knowledge.

d) Providing exploration and discovery

Creative pedagogies accept ambiguity, uncertainty and the unknown (Cremin & Barnes, 2010). They provide freedom, leave time and space for experimentation, spontaneity, and meaning negotiation (Cremin et al., 2006; Ofsted, 2010; Sawyer, 2012).

These open-ended, unstructured, exploratory contexts directly relate to the concepts of play and immersion (Cremin et al., 2006). In such contexts, students envisage what might be, explore ideas, keep options open, as well as reflect critically on ideas, actions, and outcomes (Ofsted, 2010).

e) Promoting engagement

Creative pedagogies promote students' intrinsic motivation, which fosters pleasant and effective learning processes (Amabile, 1989; de la Torre, 1993; Ferrari et al., 2009b; Runco, 2007; Sternberg & Lubart, 1999). Indeed, creative practices offer opportunities for engagement, fun, enjoyment and immersion (Cremin et al., 2006; Ferrari et al., 2009b; Sawyer, 2012). They make contents attractive so students can spend time learning without being bothered (de la Torre, 2009; de la Torre & Violant, 2003)

To do so, they call for students' interests and passions, involve them in imaginative experiences, affectively and physically, by building emotionally significant links to their life. They also challenge them, engage all their senses, use humour and surprise, and present activities in exciting or unusual contexts (Cremin & Barnes, 2010; Sawyer, 2012). As mentioned by Ferrari et al. (2009b), games can have positive impacts on students' motivation and engagement in learning processes.

f) Providing a safe and trustful environment which encourages risk-taking behaviours

Creative pedagogies provide positive, safe, non-judgemental and comfortable environments, in which all students are supported, accepted, rewarded and can freely discuss their problems (Amabile, 1989; Cremin & Barnes, 2010; Runco, 2007). Such contexts are similar to family environments (de la Torre, 2006a), in the sense that they encourage interaction, open communication and the building of trusting relationships (Ferrari et al., 2009b). Furthermore, they facilitate laughter, well-being, and a relaxed, rewarding climate (de la Torre, 2009; de la Torre & Violant, 2003). This climate is characterised by an absence of fear and acceptance of new ideas and suggestions. Finally, creative pedagogies include a climate of value, ethics, and acceptation (de la Torre, 2006a).

In such environments, students are encouraged to take risks (Cremin & Barnes, 2010; Cremin et al., 2006). They are offered the possibility to try before getting it right, do not fear mistakes (Ferrari et al., 2009b), and use failure as positive (Sawyer, 2012).

Cremin and Barnes (2010) resume the characteristics of this secure environment through contradictory elements, including highly active and relaxed; supportive and challenging; confident and speculative; playful and serious; focused and fuzzy; individualistic and communal; understood personally and owned by all; non-competitive and ambitious.

g) Adopting flexible evaluation approaches

Creative pedagogies provide supportive evaluation strategies which build security as well as provide time and tools for reflection (Cremin & Barnes, 2010). They value students' progresses instead of their mistakes, and generate a wish to go on, grow and improve deficiencies (de la Torre, 2006a).

Furthermore, instead of bringing stressful situations, assessments provide opportunities for students to express their imagination and creativity, by using different media and unusual assignments, e.g. e-portfolios, video-making, projects, etc. (Ferrari et al., 2009b).

Creative evaluation strategies appreciate students' unique responses (Ferrari et al., 2009b). They are adaptable, flexible and comprehending (de la Torre, 2006a). Furthermore, Sawyer (2012) argues that creative teaching practices connect evaluation to the causes and consequences of ideas, rather than to their quality.

h) Encouraging collaboration

Creative pedagogies encourage exchanges, solidarity and cooperative learning methods (Amabile, 1989; Craft, 2005; Runco, 2003; de la Torre, 2006a) in which teachers and students share knowledge by interacting and confronting information (de la Torre, 2009; de la Torre & Violant, 2003). Hence, teachers and students improvise together, collaboratively, in ways that help them externalize their understandings and foster metacognition (Sawyer, 2012). Furthermore, they may offer opportunities for collaboration and networking among different schools (Ferrari et al., 2009b).

i) Relying on different sources, including ICT

Creative pedagogies use a variety of multi-modal approaches and often switch between different modes and resources, according to students' objectives and needs (Cremin & Barnes, 2010; de la Torre, 2009; de la Torre & Violant, 2003). Furthermore, they generally do not restrain their lessons to textbooks (Ferrari et al., 2009b). Instead, they call for different sources, including ICT, realia (i.e. real objects), manipulatives (i.e. resources that can be manipulated), and other innovative resources.

Ferrari et al. (2009b) highlight the potential of ICT for fostering creative pedagogies. Indeed, technologies provide new ways of dealing with tasks, thus changing the nature of the activity itself and fostering creative thinking and meaning-making (Ferrari et al., 2009b; Loveless, 2008). Through a well-integrated use of technology, teachers and learners can gather information to model possible solutions to complex questions, to construct presentations and to communicate in an engaging way (Ofsted, 2010). Furthermore, the different levels of interaction and collaboration offered by technologies facilitate the personalisation of learning paths (Ferrari et al., 2009a).

Creativity and education: summary

This section reviewed the literature related to the concept of creativity as applied to the field of education. I first explored different paradigms to the study of the phenomenon, and then defined a model of analysis for exploring it in the particular context of my study. Afterwards, I explored the place of creativity in educational contexts, and elicited a set of key-characteristics of creative pedagogies, i.e. teaching strategies which enhance students' creativity.

It is now necessary to find methodologies which have the potential to apply these strategies. As mentioned by Beghetto (2010), "there is a need for creativity researchers to assist in the development, testing and implementation of new pedagogical models that simultaneously support the development of creative potential and academic learning" (p. 459). The next section explores GBL as a potential approach to fulfil this need.

2. Game-Based Learning as an approach to foster creative pedagogies

The last section explored creativity and its application to educational contexts. The concept was described as a developmental construct, which can be encouraged in all individuals, and is amenable to education. Teachers are key-players for bringing creativity to formal educational contexts. Nevertheless, they need to have models and tools for including creativity in their daily practices.

GBL seems to be a potential approach to promote creative teaching practices. Indeed, digital games, when applied to educational contexts, can promote many characteristics of creative pedagogies: they can provide challenging experiences that promote the intrinsic satisfaction of the players (Gee, 2003; Whitton, 2008); they are interactive systems, which enable learners to have an active impact on their virtual environment (Aldrich, 2005); furthermore, they provide risk-free environments in which players can play, explore, try out hypothesis and take risks (Crawford, 1984; Salen and Zimmerman, 2004; Ke, 2009).

However, it may be challenging for teachers to successfully integrate games in formal educational contexts (Kirriemuir & McFarlane, 2004; Klopfer et al., 2009; Ulicsak & Williamson, 2011). Indeed, mainstream games are usually expensive, and it can result difficult to find a game that exactly matches the curriculum and the desired learning outcomes. How to successfully integrate games in the classroom, in order to foster creative teaching practices?

This section addresses the potential of GBL for enhancing creative pedagogies. It first explores the concept of games and digital games, by examining different definitions, analysing their characteristic components, and reviewing different taxonomies. Afterwards, it concentrates on GBL: it studies the potential of digital games for learning, and explores the opportunities they offer to enhance creative pedagogies. The section then describes different perspectives to integrate games in the classroom, and concentrates on an approach where teachers design games specifically tailored to their educational objectives. With this goal, it studies the existing game authoring tools, and especially the eAdventure game editor, which enables teachers to design their own LGs. Finally, the section explores scientific literature related to the design and evaluation of LGs.

2.1. Understanding the concept of games in current times

To apprehend the potential of GBL for enhancing creative pedagogies, it is first necessary to understand the concept of game and to identify its main characteristic components. The gaming literature provides a wide background to understand the nature of games.

This subsection provides an overview of the academic literature dedicated to games. First, it focuses on defining games and digital games, as well as listing their different components. Afterwards, it moves towards the concept of Serious Game (SG) and highlights its different domains of application. Finally, it outlines the scope of the research towards digital games with an educational purpose.

2.1.1. Definitions and characteristics

Game studies describe an academic discipline which concentrates on the critical study of games. It is a multi-disciplinary field which includes researchers from different areas, such as psychology, sociology, philosophy, anthropology, arts, but also computer science, communication and media studies. If game studies have emerged as an academic discipline in the 21st century, many authors have been trying, for a long time, to describe the essence of games. This section aims to provide the main definitions given by key-authors among the history of game studies, and tries to arrive to a consensus regarding the main components of games.

From play to game

In 1938, the anthropologist Johan Huizinga published the *Homo Ludens*, which sought to define of the concept of play. He described it as a social, free activity, separated from ordinary life with boundaries of time, space and rules. Furthermore, play is regarded as both absorbing and not serious, and is not connected to any material interest and profit. The author also describes play as universal behaviour, prior to any cultural construction. In addition, the author introduces a different type of play, which is rule-based and culturally mediated. This form of play is illustrated by the *magic circle* metaphor, i.e. play is a sphere which is limited in time and space and isolates the activity from the ordinary world.

Later on, the sociologist Roger Caillois (1961) provided a comprehensive analysis of play in his book *Men, Play and Games*. The author defines play as a free (i.e. non obligatory) activity, separated within limits of space and time, and governed by specific rules. The course and the result of the activity are uncertain. Furthermore, playing is unproductive, as it does not create any goods. Finally, the activity is “accompanied by a special awareness of a second reality or of a free unreality, as against real life” (Caillois, 1961, p. 10).This definition brings some new elements to the Huizinga’s one, such as the description of play as an uncertain activity, and the sense of make-believe associated to it.

The game designers Katie Salen and Eric Zimmerman (2004) argued that these two definitions provide some representative elements of the nature of play, but do not address the particular instance of games. Nevertheless, Caillois (1961) introduced, for the first time, a distinction between *play* and *game*, with the concepts of *paidia* and *ludus*, which are the two extremes in the continuum of play activities. The former refers to playing, a free, spontaneous and expressive activity, while the latter is about gaming, i.e. bringing the elements of playing in structured activities with explicit rules and goals.

Games as formal systems

Later on, literature got closer to the concept of games, by defining them as formal systems. For example, the game designer Chris Crawford (1984) described different characteristics of game, i.e. representation (they constitute closed formal systems which represent a part of reality), interaction (they enable players to explore reality changes, and let them generate causes and observe effects), conflict or challenge (some obstacles prevent players from achieving their objectives), and safety (they provide a safe environment to experience reality).

Furthermore, after an analysis of eight different definitions of games, Salen and Zimmerman (2004) underlined the following characteristics: (a) *system*: games are systems consisting of interrelated elements which form a complex whole; (b) *players*: games are actively played by one or more participants; (c) *artificiality*: they maintain a boundary from real life in time and space; (d) *conflict*: players take part in a conflict with each other or with the game system; (e) *rules*: games provide a structure which defines what the player can and cannot do; and (e) *quantifiable outcome*, which distinguishes a game from less formal play activities.

Many other authors from different fields also provided definitions. For example, the game theorist Jesper Juul (2005), known for his research in game studies, included some additional elements in comparison to Salen and Zimmerman's one, such as the variable character of the outcome, and the effort that players have to dedicate in order to reach their goal.

Towards a consensus: an open definition

In the field of education, Nicola Whitton (2010) adopted an approach which defines games according to key-characteristics, but which accepts that not all games necessarily include each of the characteristics. This open definition gathers ten characteristics of games which commonly appear in the definitions above cited. Following this approach, activities which display at least some of these characteristics are considered to be game-like or game-based. The more of these characteristics an activity exhibits, the more game-like it is considered to be.

- *Competition:* the goal of the activity is to achieve better results than other players. In contrast, competition can consist of individuals competing against themselves.
- *Challenge:* the task has some degree of difficulty and requires efforts.
- *Exploration:* the activity takes place in a simulated environment which includes places, objects and people. The player can discover and interact with these elements through exploration.

- *Fantasy:* a make-believe, fictional environment, including the narrative and the characters that inhabit the game world.
- *Goals:* the game presents explicit objectives, with a clear purpose, so that players know what they have to achieve. Goals can either apply to the game as a whole, or be smaller sub-goals to be completed in order to achieve the overall aim of the game.
- *Interaction:* the player can transform the state of the game by taking action and, in turn, the game provides feedback to the player.
- *Outcomes:* games provide measured results (e.g. scoring) which inform on the degree to which a goal has been achieved or how far the player is progressing towards a goal.
- *People:* other individuals may take part in the game, either simultaneously, in real time or asynchronously. Players can play in a competitive or collaborative manner.
- *Rules:* they provide a set of instructions on how to play the game, and present boundaries, limitations or constraints.
- *Safety:* games are consequence-free environments that can be experimented without the outcomes having consequences in the real world.

I selected this approach for the purpose of my research. Indeed, instead of focusing on a single definition which would lead to a dichotomy between game and non-game, "it allows the inclusion and consideration of a range of game-like activities that are interesting in terms of their educational value" (p. 22).

2.1.2. From games to digital games

Some definitions do not differentiate between digital and non-digital games. However, digital games present some unique qualities that are worth describing.

Crawford (1984) describes computer games as games played on different types of computers, such as dedicated arcade, *handheld* machines and personal computers. The computer plays the role of the opponent and referee, as well as provides animated graphics.

In addition, in their review of computer games and learning for Nesta Futurelab, the game researcher John Kirriemuir and the educationalist Angela McFarlane (2004) define digital games as the ones that provide visual digital information, take input from players, process this input according to a set of rules, and alter the digital information provided to players. Similarly, Salen and Zimmerman (2004) highlight four traits that summarize the special qualities of digital games:

- *Immediate but narrow interactivity:* they include systems of actions and outcomes, so to dynamically respond to players' decisions and inputs.
- *Manipulation of information:* they manipulate different kinds of information (i.e. text, images, video, audio, and animations) in ways that non-digital games cannot. For example, board games require learning the rules before the game begins. In contrast, digital games offer the possibility to learn the rules as they are being played.
- *Automated complex systems:* in most board games, players have to manipulate the game elements at every step, according to the instructions outlined by the rules. In a digital game,

the program automates these procedures and moves the game forward without requiring any direct input from a player.

- *Networked communication:* some digital games facilitate communication between players, by providing email, text chat, or real-time video and audio communication systems.

Some authors distinguish between different types of digital games. For example, Juul (2005) differentiates computer games (games played on a personal computer) and videogames (games which use computer power and a video display, e.g. a computer, cell phone, or console). In addition, in their Futurelab handbook on computer games and learning, the educational researchers Mary Ulicsak and Ben Williamson (2011) make the following distinctions:

- *Digital games* refer to all games that have a digital technology base;
- *Electronic games* include handheld games consoles, games consoles connected to a television, computer games online, computer games on a PC or CD ROM games;
- *Video games* indicate those used with television-linked consoles and portable video game systems;
- *Computer games* constitute those played directly on a PC;
- *Online games* design Massively Multi Online Role Playing Games (MMORPGS) and casual (i.e. intuitive, accessible, and easy to play) games;
- *Mobile games* are those played on a handheld device (including mobile phones, mobile consoles and tablet computers).

In this dissertation, the term digital games is used, in order to embrace all the types of game based on digital technologies, and which may enhance creative teaching practices.

The different genres of digital games

This dissertation mentions digital games of different genres. As discussed later, the educational potential of a game is sometimes closely related to its genre. Therefore, it seems necessary to provide a brief review of existing game genres and typical examples.

As highlighted by the game researchers Damien Djaouti, Julian Alvarez, and the designer Jean-Pierre Jessel (2011), many classifications emerge from the subjective analysis of players and the gaming press. Basing on these classifications, several designers and academics produced more reliable taxonomies. For example, Crawford (1984) divides games in two different genres, i.e. skill-and-action and strategy, each genre including different categories; the educationalist and game theorist Marc Prensky, (2001) recognizes eight genres of games, including action, adventure, fighting, puzzle, role playing, simulations, sports, and strategy; similarly, the educationalist Begoña Gros (2007) categorises seven game genres; the game designers Andrew Rollings and Ernest Adams (2007) propose nine genres of game, adding vehicles-simulations, construction-and-management-simulations, and online-games. Nevertheless, it is increasingly difficult to establish stable categories, given the fast evolution of the game market (Gros, 2009).

Besides of examining the characteristics of games, my research considers their benefits and potential to teach particular skills to learners. Whitton (2010) provided an overview of the main types of digital games, according to their learning affordances. She distinguished between seven different genres:

- *Adventure:* these games offer virtual worlds in which players perform actions, talk to characters and solve puzzles in order to achieve the objectives of the game, often consisting of solving a quest. These games generally depend on mental agility. They can provide opportunities for problem-solving and lateral thinking, where players carry out the appropriate actions in order to achieve their goal. Examples of this genre include the famous series of *Monkey Island*[8] and *Zelda*[9].
- *Platform:* in these games, players move through a landscape, avoid obstacles and enemies, and pick up treasures, with a general objective in mind. They develop different types of skills, including hand-eye coordination, planning and strategizing, problem-solving and the ability to think quickly. *Super Mario Bros*[10] is the most famous example of this genre.
- *Puzzle:* this genre includes problem solving games of many forms (e.g. *Tetris*[11] and *the Incredible Machine*[12]). They can be used to support different types of learning depending on the type of puzzle, including logic, spatial awareness, verbal skills, numeracy skills, and spelling. The author also includes quizzes in this category.
- *Role-play:* players take on the role of different characters and engage in diverse tasks, including solving quests, fighting, treasure hunting, and interacting with other characters. These games provide opportunities for building collaborative skills, social interaction, management of complex systems, and strategy. *EverQuest*[13] is a famous example of this genre.
- *Shooter:* these games consist of using weapons in order to beat opponents (e.g. *Doom*[14]). Although it is argued that this genre is less applicable to learning, such games can enhance the acquisition of many skills, including forward planning, strategizing, and team working.
- *Sports:* these games simulate sporting events or tournaments. They can be used to practice the skills of a particular sport, tactics, rules and the ability to think and make decisions quickly. A famous example is the *Fifa*[15] series.
- *Strategy:* they consist of making strategic decisions in order to meet specific goals. They can be used for teaching planning, decision-making, testing hypotheses, strategic thinking, management skills and seeing the consequences of actions taken. Two examples of this genre are *Lemmings*[16] and *Civilization*[17].

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[8] www.lucasarts.com/games/monkeyisland2/#/home

[9] www.zelda.com

[10] http://mario.nintendo.com/

[11] www.tetris.com/

[12] www.mobygames.com/game-group/incredible-machine-series

[13] www.everquest.com/

[14] www.mobygames.com/game/doom

[15] www.ea.com/fifa

[16] www.mobygames.com/game/lemmings

In the context of my study, I related to this taxonomy. Although it specifically relates to the context of higher education, it puts forward the idea “that different types of game exist and each has different benefits and drawbacks in terms of their applicability for learning” (Whitton, 2010, p. 56). Figure 4 presents screenshots from some of the titles afore mentioned.

Figure 4: Screenshots from different genres of games: Zelda, Monkey Island and the Incredible Machine

2.1.3. Serious games

As highlighted by the game designers David Michael and Sande Chen (2006), digital games have been recently used to educate, train, and inform. The term *Serious Game* (SG) was first used by Clark Abt (1970) to differentiate between games for fun and games for learning. In his book, he presented examples of simulations and games to be used for educational purposes. He mainly referred to the use of board and card games. Nevertheless, he proposed a definition which can easily apply to digital games: “Serious Games have an explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement” (p. 9).

Among the first SGs, we can cite Operation Frog[18], a simulation where players can explore the body of a frog. Later on, in 2002, the simulation game America’s Army[19], developed by the United States Army, was widely diffused for a recruitment campaign in order to provide players with a virtual soldier experience and value the image of the army. The game captured people’s attention to the SG movement. In 2003, the game designer Ben Sawyer organized the first conference on SGs: the Serious Games Day[20], which was followed by some major events which shaped the current SG industry: the Serious Games Initiative[21], the Serious Game Summit[22] and Games for Health[23].

Consequently, SGs became a dedicated body of research. They were defined by Chen and Michael (2006) as “games that do not have entertainment, enjoyment or fun as their primary purpose” (p. 21).

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[17] www.mobygames.com/game/sid-meiers-civilization

[18] Interactive Picture Systems Inc.

[19] www.americasarmy.com/

[20] www.wilsoncenter.org/event/serious-games-day

[21] www.seriousgames.org

[22] www.seriousgamessummit.com/

[23] http://gamesforhealth.org/

In contrast, the computer scientist Michael Zyda (2005) provides a definition which brings focus to the entertainment component: "a mental contest, played with a computer in accordance with specific rules that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives" (p. 26).

At the difference of Abt, these two last definitions show that the use of SGs does not longer exclusively apply to educational purposes. Instead, it has been extended to a wide range of applications, such as information, persuasion, expression, recruitment and indoctrination (Michael & Chen, 2006).

For example, the United Nations World Food Programme published *Food Force*[24], aimed to raise children' awareness on hunger and the work of the aid agency, while *Darfur is Dying*[25] intends to sensitize players to the crisis in Darfur.

Regarding politics, Serious Games Interactive[26] developed *Global Conflicts: Palestine*[27], an immersive role-playing simulation which enables the player to explore, through different stories, the Israeli-Palestinian conflict, in relation to human rights and the role of media.

SGs for marketing purposes, called *advergames*, are widely used for advertising products or organizations. For example, *Pepsi Invaders*[28] is a variation of the famous *Space Invader*[29]. There also exist anti-advert games, like the *MacDonald's Videogame*[30], a satire which presents the business practices employed by the corporate under a negative light.

Regarding healthcare, some SGs aim to train medical staff, such as the multiplayer simulation *On Call* (developed by the University of Massachusetts Medical school[31] and the Massachusetts Digital Games Institute[32]), in which players can experience different medical team roles while dealing with important factors such as time and efficiency. Furthermore, some games raise awareness about health issues, such as *Fatworld*[33], in which players learn about obesity and the politics of nutrition. Finally, other SGs are used in the treatment of specific pathologies, e.g. *MINWii*[34], a musical serious game for patients suffering from Alzheimer's disease.

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[24] www.wfp.org/videos/food-force

[25] www.darfurisdying.com

[26] www.seriousgames.dk/

[27] www.globalconflicts.eu/

[28] http://serious.gameclassification.com/EN/games/1230-Pepsi-Invaders/index.html

[29] /www.arcade-history.com/?n=space-invaders&page=detail&id=2537

[30] www.mcvideogame.com/

[31] www.umassmed.edu/

[32] www.massdigi.org/

[33] http://fatworld.org/game.php

[34] http://minwii.org/

Finally, game characteristics present many advantages relevant to the education field. In this line, *Quest Atlantis*[35] aims to immerse students from 9 to 15 into meaningful inquiry tasks, while *Conspiracy Code*[36] is an immersive 3D game related to American history.

In the context of my study, I focused on the last category, i.e. SGs applied to the educational field. Figure 5 presents some of the titles mentioned above.

Figure 5: Examples of SGs: Food Force, MacDonalds Videogame, Fatworld and Darfur is Dying

2.1.4. Focus of the study and terminology

In this subsection, I presented the concept of game through a series of definitions and characteristic elements. I also selected a taxonomy of seven games genres, and highlighted their respective educational affordances. Finally, I introduced the concept of SG, together with its different applications.

The scope of my research is on digital games with an educational purpose. In this dissertation, I chose to call them Learning Games (LGs). First, I decided to discard the term Serious Game: although the initial definition proposed by Abt (1970) corresponds to the object of my study, the last sections showed that the term has become plural and applies to distinct domains. The educationalists Hirumi, Appelman, and Van Eck (2010) used the term "instructional game", as opposed to "educational

[35] http://atlantisremixed.org/

[36] www.360ed.com/Products/Conspiracy-Code-American-History/

game", to reflect the distinction between macro-level educational goals (what the educational system aims for) and the micro-level instructional goals (what a course, or module aims for). I chose, however, to not use the term instructional, which refers to a specific field in pedagogy. In contrast, the term Learning Game is more general, and often associated to GBL. Indeed, it has been widely used in the Learning Game Network[37] and in conferences like the Game Based Learning Conference[38] and the European Conference on Games Based Learning[39].

Now that the focus of the research towards games has been established, it is time to explore the body of research which contemplates the application of games for learning, i.e. GBL.

2.2. Game-Based Learning

For a long time, many researchers have highlighted a clear relation between learning and playing digital games, such as the psychologists Malone and Lepper (1987) and the GBL researchers Kowit Rapeepisarn, Kok Wai Wong, Chun Che Fung and Myint Swe Khine (2008). Indeed, digital games promote a new learning culture which better matches students' interests (Prensky, 2001). As argued by the GBL researcher James-Paul Gee (2007), they provide challenging experiences that promote intrinsic satisfaction, and possess many qualities which can facilitate learning processes. Particularly, they are regarded as an ideal medium for learning in the 21st century (Ulicsak & Williamson, 2011). In their literature review on gaming and education, Katie Larsen McClarty, Aline Orr, Peter Frey, Robert Dolan, Victoria Vassileva and Aaron McVay (2012) argue that games constitute potential tools to teach and strengthen skills that are important for future jobs. For example, the Horizon Report (Johnson et al., 2013) highlights their ability to foster critical thinking, creative problem-solving and teamwork. Furthermore, the GBL researcher Clark Aldrich (2005) showed their potential to support learning by doing processes and meaningful learning experiences. As mentioned by Gee (2009), "digital games are, at their heart, problem solving spaces that use continual learning and provide pathways to mastery through entertainment and pleasure" (p. 67).

This subsection focuses on the field of GBL. It first presents the scope of this approach, and then explores the potential of digital games for enhancing creative pedagogies, as described in literature. Afterwards, it moves towards the different approaches to introduce digital games in the classroom, and concentrates on the creation of LGs. It then reviews the different existing game authoring tools, and focuses on the eAdventure game editor, which enables teachers to design their own LGs. The section terminates with some examples of application of GBL methodologies in the context of my research, i.e. Spanish primary and secondary educational settings.

2.2.1. The scope of GBL

In their recent review on GBL, Perrotta, Featherstone, Aston, and Houghton (2013), argue that "game-based learning broadly refers to the use of video games to support teaching and learning" (p.

[37] www.learninggamesnetwork.org

[38] www.gamebasedlearning2010.com

[39] http://academic-conferences.org/ecgbl

5). The authors highlight the key-principles of GBL, i.e. intrinsic motivation (playing is voluntary and self-driven), learning through enjoyment and fun, authenticity (contextual, goal oriented instead of abstract learning), autonomy and experiential learning (learning by doing). Furthermore, Prensky (2001) highlights the potential of GBL, by defining it as "the combination of digital games with a wide variety of educational content, achieving as good or better results as through traditional learning methods in the process" (pp. 145-146).

The GBL research field has recently attracted the interest of both researchers and educational communities (McClarty et al., 2012; Van Eck, 2006; Whitton, 2008). Indeed, educators acknowledge that children learn better through play (Rapeepisarn et al., 2008). Furthermore, the thinking patterns of learners have changed, and their experience with digital games "has shaped their preferences and abilities and offers an enormous potential for their learning" Prensky (2001, p. 16).

Now that GBL has gained a wide acceptance among the educational communities (Kirriemuir & McFarlane, 2004; Van Eck, 2006), the aim of GBL researchers is to investigate how digital games (either commercial or specially designed for educational purposes) can be best integrated in teaching and learning contexts, increase students' motivation and meet the requirements of curricular objectives (Kirriemuir & McFarlane, 2004; Squire & Barab, 2004; Van Eck, 2006).

The current challenge faced by GBL researchers is to reach a balance between fun and learning (Moreno-Ger et al., 2008; Prensky, 2001). Indeed, *edutainment* approaches (i.e. initiatives focusing on transferring educational content into a game-like environment) give priority to content to the detriment of entertainment aspects, thus losing most of the benefits of GBL regarding motivation and engagement (Moreno-Ger et al., 2008). On the other hand, approaches which leave aside the educational value to give advantage to fun have little impact on the learning outcomes. Both factors are indispensable to provide enjoyable and profitable learning experiences. As mentioned by the game researchers Klopfer et al. (2009):

> The process of designing and creating educational games can be thought of much like the process of baking. There are many attempts by a growing number of health conscious cooks to make things that are both yummy and healthy. It isn't easy to balance these two qualities (p. 25).

2.2.2. Understanding the potential of games for enhancing creative pedagogies

Numerous studies have highlighted the potential of digital games for learning (Aldrich, 2005; Gee, 2005; McClarty et al., 2012; Prensky, 2001; Rapeepisarn et al., 2008). For example, Gee (2003) provides a list of 36 learning principles that digital games can enhance. While reviewing a wide range of studies, I could identify a clear relationship between GBL and creative pedagogies. The next paragraphs describe the potential of GBL for enhancing each of the key-characteristics of creative pedagogies, as highlighted earlier in this review (Section 1.4.2).

a) Promoting learner-centred methodologies

Prensky (2001b) highlights a gap between learners' expectations and what they are taught in the school. Indeed, today's students are digital natives, who have grown up in a world where interactive digital media (e.g. computers, the internet, mobile phones or computer games) have always existed, and which differs from the pedagogical resources habitually used in classrooms (Aldrich, 2005; Prensky, 2001b; Ulicsak & Williamson, 2011). Digital games have become a major part of young people's leisure time, as well as a significant cultural force in their lives (Gros, 2007, 2009; Rapeepisarn et al., 2008; Ulicsak, 2010; Ulicsak & Williamson, 2011). In this sense, games connect to students' life, interests, as well as new ways of thinking and processing information (Ulicsak & Williamson, 2011).

In addition, games are user-centred (Gros, 2007). They provide a learning path which continuously adapts to students' rhythm and performance. Indeed, following Gee's *ongoing learning* principle (2003), players must learn new skills as they surpass levels in a game, in order to adapt to new conditions. Furthermore, they have the possibility repeat the same scenario until the skill is mastered. This scaffolding system allows for the introduction of new concepts through a logical learning progression, following learners' rhythms and needs. Finally, games provide an opportunity to personalize learning according to students' profiles and level of skills (McClarty et al., 2012). Indeed, Gee's *multiple routes* principle refers to a personalized learning process which enables players to make choices and rely on their own strengths and styles of learning. Furthermore, games can adapt on students' specific profiles and learning styles, as some of them enable players to customize game play (Gee, 2003).

b) Allowing for self-learning

Digital games are interactive. At the difference of books, they "talk back" to players as a real dialogue (Gee, 2005, p. 34). Indeed, nothing happens until players act and make decisions. In response, the game reacts, gives feedback and presenting new problems dialogue (Gee, 2005). Hence, games enable learners to have an active impact on their virtual environment.

Furthermore, Gee's *active, critical learning* principle (2003) refers to the iterative process through which players learn in games. They do and then reflect, do some more and reflect more, having learnt to do better. In this sense, digital games enable players to feel a real sense of agency, control and ownership over their actions (Gee, 2005).

This scaffolding system can be compared to Vygotsky's ZPD, i.e. "the distance between the actual developmental level as determined by independent problem solving, and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers" (Vigotsky, 2006, as cited in McClarty et al., 2012, p. 12). As mentioned by the authors, games provide this guidance in order to help players meet the next challenge.

Finally, to Gee (2005), games allow for production. In his words, "players are producers, not just consumers; they are "writers," not just "readers" (p. 35). Hence, players co-design their game experiences through their actions and decisions. As a result, digital games constitute an ideal medium to promote learning by doing processes (Aldrich, 2005), and are strongly related to constructivists theories (Gee, 2007). They turn students into the leader of their own learning experience, without requiring the intervention of an instructor.

c) Helping to make connections

To Gee (2005), games help players to think about relationships, as opposed to isolated events. Indeed, players need to reflect on the way their actions will affect their future actions, and, in some cases, the actions of the other players playing against them.

In this line, Gee's *transfer* principle (2003) states that learning can be internalised and then used at a later time. Indeed, digital games can provide authentic learning environments (Perrotta et al., 2013; Ulicsak & Williamson, 2011) in which students face simulated environments where they deal with similar situations to the ones faced by professionals. As a result, games enable learners to experience learning within a situated context that makes sense to them. As argued by the educational researcher Fengfeng Ke (2009), they offer simulated visualization, authentic problem solving, and instant feedback, which provide a realistic framework for situated understanding.

d) Providing exploration and discovery

Games are a form of play (Prensky, 2001). As stated by Klopfer et al. (2009), "the starkly obvious difference between games and traditional schooling is that good games always involve play, and schooling rarely does" (p. 4). The authors define play along five types of freedom, i.e. freedom to fail, to experiment, to fashion identities, as well as freedom of effort and of interpretation.

Digital games promote the experience of all of these freedoms. As highlighted in Gee's *discovery* principle, learning in games occurs as players try things out and experiment, i.e. they think, prepare, and implement actions within a simulated environment (Gee, 2003). Games provide short feedback cycles, which enable players to experiment their hypothesis through trial and error processes (Gee, 2005; Ke, 2009). Furthermore, players are given the opportunity to try out different roles and identities (Gee, 2003). Finally, the freedom of effort aforementioned is present in any voluntary game (Klopfer et al., 2009).

In addition, Gee (2009) argues that games engage players by placing them in worlds where they experience new thing. This immersive experience can enhance deep learning processes, as people mainly learn through concrete experiences, rather than through abstract calculations and generalizations.

e) Promoting engagement

Regular classroom activities are often considered to be boring (McClarty et al., 2012). In contrast, digital games can foster students' engagement with learning tasks (Gros, 2007). Indeed, the most cited argument for using games in educational settings is their potential to enhance students' intrinsic motivation and to capture their attention so that learning happens almost without students realising it (Gee, 2003; Ulicsak & Williamson, 2011; Whitton, 2008).

Prensky (2001) highlights 12 elements that explain why games engage us, including fun, interaction, outcomes, feedback, conflict, representation and story. In the same line, Leblanc (as cited in Salen & Zimmerman, 2004) propose a typology which lists eight categories of pleasure providing by games, namely sensation, fantasy, narrative, challenge, fellowship, discovery, expression, and submission.

Gee's *identity* principle (2003) assumes that games capture players' attention through identity, i.e. they either have the chance to integrate an appealing character, or to build a character from zero. Consequently, players become committed to their new identity and to the game (Gee, 2005).

The game designer Jenova Chen (2007) highlighted the relationship between digital games and flow. Other authors (Chen, 2007; Kirriemuir & McFarlane, 2004; Perrotta et al, 2013; Salen & Zimmerman, 2004) recognized this connection. Indeed, descriptions of the flow experience are similar to what players experience when they play games, i.e. they lose track of time and external pressures (Chen, 2007; McClarty et al., 2012). Furthermore, games present many of the flow antecedents highlighted by Csikszentmihalyi, such as clear goals, direct and immediate feedback, balance between skills and challenge, and sense of control (Chen, 2007; McClarty et al., 2012). These components can increase students' engagement, which is strongly associated with learning achievement.

f) Providing a safe and trustful environment which encourages risk-taking behaviours

To Gee's *psychosocial moratorium* principle (2003), games encourage risk-taking and exploration. Indeed, they present a risk-free environment in which students can experiment different options without fearing to fail. By adhering to a fictional setting or role, players try out skills and identities without suffering the consequences of failure in real life (Perrotta et al., 2013). Instead, failures are positive in games, as players can use them as ways to understand new patterns and progress towards their goal. Hence, failure serves as an integral part of the learning experience (Gee, 2005, 2009; Ke, 2009; Klopfer et al., 2009; McClarty et al., 2012).

g) Adopting flexible evaluation approaches

As stated by McClarty (2012), games are inherently assessments. Indeed, they share underlying characteristics with traditional assessments that enable to quantify knowledge and abilities. Assessment in games occurs naturally, as the engine analyses players' actions and responds immediately. Hence, games can serve as non-invasive assessments which provide continuous information and reduces the amount of pressure placed on students.

According to Gee's *probing* principle (2003), players can reflect on their actions, form a hypothesis, test it, and then accept or rethink it. Hence, players can improve through repeated practice (McClarty et al., 2012).

h) Encouraging collaboration

Games are often reported to provide opportunities for collaborative learning (Gros, 2007; Klopfer et al., 2009; McClarty et al., 2012). For example, Gee (2005) finds that *World of Warcraft*[40] enhances

[40] http://us.battle.net/wow/en/

collaboration among players who work in cross-functional teams in order to achieve common objectives.

To Whitton (2010), games enable students to work together, learn from others and test their understandings. Collaboration can either take place during the time the game is played, or outside the game, e.g. multi-user games involving turn-taking in the same physical space, single player games with synchronous online communication, single-player games with face-to-face communication or reflection.

i) Relying on a series of sources, including ICT

Finally, Gee's *multimodal principle* (2003) considers that learning in games occurs through the mix of various information sources, including text, graphical images, sound and other events. Consequently, games provide "fast, active and exploratory tasks, with information supplied in multiple forms in parallel" (Kirriemuir & McFarlane, 2004, p. 3). Hence, digital games present a powerful potential regarding the acquisition of digital competences (Gros, 2007, 2009).

This analysis enabled to highlight the potential of GBL to support creative pedagogies. Indeed, digital games can enhance each of the key-characteristics presented in Chapter 2.

2.2.3. Different approaches to integrate digital games in formal education contexts

After examining the potential of digital games for promoting creative teaching and learning practices, I now move towards a practical perspective, and look at the different options available to educators for integrating digital games in their educational contexts.

Any approach that combines games with education can be regarded as GBL (Moreno-Ger et al., 2008). The following subsections provide an overview of these approaches, which can be categorized into three different groups (Moreno-Ger et al., 2008): (a) edutainment, i.e. multimedia approaches linked to content presentation; (b) approaches which repurpose existing games for educational purposes; and (c) the use of purposefully designed games in order to balance fun and educational content.

a) Edutainment

As mentioned earlier, these initiatives focus on converting educational content into game-like environments. Hence, titles are designed on the basis of their content, and game elements are later added to this content (Moreno-Ger et al., 2008). These approaches assume that learning occur with the opportunity to practice certain skills enough times (Gros, 2007). Hence, they are often based on behaviourist principles (Ulicsak, 2010), i.e. tests or drill-and-practices exercises completed by extrinsic rewards (Whitton, 2010). Most of these initiatives have proved to be unproductive, due to their simplistic, repetitive aspects, as well as their poor design which do not support progressive learning processes (Gros, 2007). As a result, learning becomes a forced and conscious process (Kirriemuir & McFarlane, 2004).

b) Repurposing existing games for education

This second approach consists of using mainstream games, explicitly designed to provide engaging experiences, for educational purposes (Moreno-Ger et al., 2008). For example, the GBL researchers Squire and Barab (2004) reported the successful use of *Civilization III*[41] in the context of a course related to world history and humanities. Furthermore, Gros (2007) described the application of *Age of Empire II*[42] in the classroom to enhance social sciences and maths. Such initiatives are advantageous regarding cost-effectiveness (Moreno-Ger et al., 2008).

Nevertheless, many authors identified numerous challenges to the integration of commercial games in formal educational contexts (Gros, 2007; Kirriemuir & McFarlane, 2004; Klopfer et al., 2009; Ulicsak & Williamson, 2011). Among them, I highlight the following:

- *The difficulty of aligning games with curriculum requirements:* it may be challenging to find a game which matches the particular components of the curriculum (Gros, 2007; Ulicsak & Williamson, 2011). Indeed, games usually present interdisciplinary contents (Gros, 2009). Furthermore, they often contain irrelevant contents or functionalities which cannot be taken away (Ulicsak & Williamson, 2011). As mentioned by Klopfer et al. (2009), schools are generally reluctant to adopt educational technologies that do not directly link to standards.
- *Negative attitudes of some parents and educators towards digital games:* it is sometimes difficult for teachers to persuade other stakeholders in their schools to use this type of tools (Gros, 2009; Kirriemuir & McFarlane, 2004; Klopfer et al., 2009). This issue is related to the cultural acceptance of games as resources which can promote learning (Kirriemuir & McFarlane, 2004; Ulicsak & Williamson, 2011).
- *Technical and logistical issues:* teachers often find it difficult to include game activities in the structure of school day (Klopfer et al., 2009; Ulicsak & Williamson, 2011). Furthermore, the access to computers is limited in some schools. The selected games should be compatible with school hardware, licencing agreements and budget (Kirriemuir & McFarlane, 2004; Ulicsak & Williamson, 2011).
- *The lack of support for teachers:* most teachers lack knowledge regarding GBL practices, and professional development programs do not address this topic (Klopfer et al., 2009; Ulicsak & Williamson, 2011).
- *Assessment:* skills that are taught through games are not assessed in standardized exams. Thus, new frameworks for assessment are needed in order to align games with the assessment framework that are used in schools (Klopfer et al., 2009).

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[41] www.civ3.com/

[42] www.microsoft.com/games/age2/

c) Creating LGs tailored to particular teaching objectives

This last approach consists of designing games in order to reach a balance between fun and educational content (Moreno-Ger et al., 2008). It allows for the alignment of learning outcomes with gaming outcomes, for specific curricular objectives and student profiles (Whitton, 2010). While it requires a certain technical expertise, a growing number of tools can facilitate game design, which I detail in the next subsection.

Nevertheless, some authors (Klopfer et al., 2009; Moreno-Ger et al., 2008) highlight some barriers to the design of LGs, including the high costs of development and maintenance, the limited sources of funding in educational systems, the development processes (they do not involve collaboration with educational practitioners), and the difficulty to access classrooms for play-testing the game with target audience, which limits the effectiveness of the internal evaluation process.

d) Additional approaches

Besides the approaches mentioned by Moreno-Ger et al. (2008), Whitton (2010) describes four more options available to educators for integrating games in their teaching practices:

- *Modifying existing games to improve their educational value:* some games provide an additional creation engine that enable to develop extensions. Although this approach can reduce the development cost, it may be challenging to find an appropriate game design which matches particular educational objectives on the basis of the characteristics of the original game.
- *Using commercial LGs:* this approach refers to the use of commercial games specifically designed for learning. However, these games are often expensive, and may be difficult to customize when they do not suit the exact requirements of the teaching context.
- *Using virtual worlds:* the use of multi-user virtual environments for learning has recently increased. Although these worlds are not considered to be games, they constitute interactive and explorative environments.
- *Learners as game creators:* instead of playing, students can learn by designing games themselves. Many game development tools make this option feasible, although students need some technical and design expertise.

My research focused on the creation of specifically designed LGs. While this may seem to be a difficult option, it presents the advantage to obtain a game which meets exactly the pedagogical objectives addressed, as well as the practical needs of the teaching session and the curricular requirements (Whitton, 2010). The next subsection reviews different game editor tools, in order to study how to overcome these obstacles.

2.2.4. Existing game editors

Recently, numerous authoring environments have been proposed to facilitate game design by people with low technical skills. Among them, Torrente, Moreno-Ger, Martínez-Ortiz, and Fernandez-Manjon (2009) highlight FPS Creator[43] (which enables to easily create shooter games), The 3D Game

[43] www.fpscreator.com

Maker[44] (a digital game creation environment originally developed as a tool to teach game design). In addition, Adventure Maker[45] enables to create adventure games. Finally, Mission Maker[46] and Alice[47] enable to create games specifically purposed for education. However, they require technical skills which are beyond the level of most instructors.

A study conducted by ProActive consortium (Annex 1.1) on existing game editor tools highlights the difficulty to find environments specifically designed for the creation of LGs by educators. Indeed, most tools do not support the inclusion of learning-oriented features (e.g. the evaluation the student's performance).

The eAdventure game editor

The eAdventure editor is an authoring platform developed by the <e-UCM> research group[48] (Complutense University of Madrid), which aims to facilitate the creation of LGs for people without a technical background, mainly teachers or students (Torrente et al., 2010). The platform enables to develop point-and-click 2D adventure games.

The tool facilitates the integration of LGs in educational processes and in e-learning systems (e.g. Learning Management Systems like *Moodle*[49]). Furthermore, it allows for the exportation of games as *Learning Objects* which can be shared in repositories (e.g. the AGREGA[50] repository developed by the Spanish ministry of education).

Using eAdventure

The tool includes two components, i.e. a game editor (see Figure 6) used to create the games, and a game engine (see Figure 7) used to run them. Hence, the design process consists of creating and testing the games with the editor, and then using the editor's exportation features to produce a package which includes all the assets required to process the game.

[44] http://t3dgm.thegamecreators.com

[45] www.adventuremaker.com

[46] www.immersiveeducation.com/MissionMaker

[47] www.alice.org

[48] www.e-ucm.es

[49] https://moodle.org/

[50] www.proyectoagrega.es

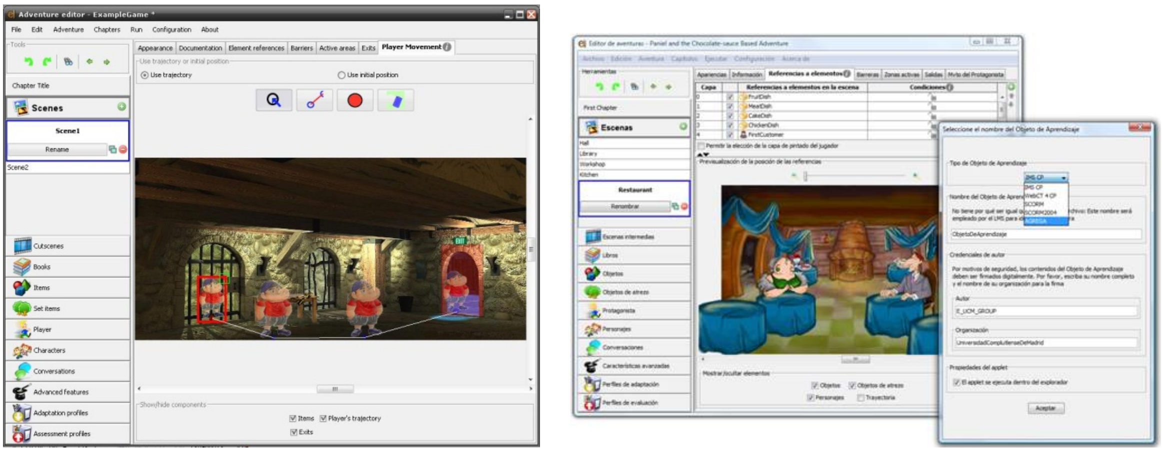

Figure 6: Screenshots of the eAdventure editor software

The development process consists of setting elements of different types, i.e. characters, items, active areas, and the game scenarios, which are composed by a 2D background image and a set of interactive elements. Furthermore, the editor includes educational features and tries to simplify the game creation process as much as possible. It follows the WYSIWYG principle (What-You-See-Is-What-You-Get) and does not involve any explicit coding or scripting (Torrente, Vallejo-Pinto, Moreno-Ger, Fernandez-Manjon, 2011).

As a result, the eAdventure games consist of two dimensions navigational environments composed by scenes (made up by a background image) which are interconnected (as defined by the author of the game). Players solve the challenges set by the game author and explore the scenes by using the mouse to discover the interactive elements (Torrente, Vallejo-Pinto, Moreno-Ger, Fernandez-Manjon, 2011). Furthermore, games include different types of media, such as images, videos and sounds.

Figure 7: Screenshots of the eAdventure engine software

The choice of adventure point-and-click games

As mentioned earlier, some game genres are more suitable for educational purposes than others. The eAdventure platform focuses on the point-and-click adventure game genre. This genre was chosen by the developers in order to reduce the technical requirements and development costs of the games, as well as to retain both students' interest and educational value (Torrente et al., 2009). Indeed, adventure games fit the needs of educational gaming for a broad set of domains (Gros, 2009). Furthermore, they offer a context for problem-solving and lateral thinking processes (Whitton, 2010).

A response to technical and distribution issues

The eAdventure platform was developed to address several barriers to the conception of LGs (Torrente et al., 2010):

- *High development costs:* as mentioned earlier, one of the main barriers to the design of LGs their high development costs. The eAdventure editor addresses this challenge, by enabling educators to produce their own LGs, or reusing games creating by others.
- *Difficulty of involving educators in the design process:* involving educators in the development of LGs is a prerequisite to achieve a good educational value. The eAdventure editor is instructor-oriented and does not require any technical background. This enables instructors to design their own games or contribute to their production.
- *Balancing educational value and entertainment:* by involving educators as domain experts and facilitating the creation of adventure games, the platform ensures the creation of resources which promote both fun and learning.
- *Delivery and assessment:* games are often complex to integrate in the teaching process, as they require specific technical equipment and installation process. Furthermore, instructors may meet difficulties in assessing the GBL experience. The eAdventure tool allows for the integration of the games in e-learning environments like *Moodle,* and facilitates their distribution to schools' computers without requiring any installation. Furthermore, it provides functionalities which enable to evaluate students' learning outcomes.

Rationale for using eAdventure in the study

The eAdventure platform seems to be one of the more advanced editors for facilitating the creation of LGs. Indeed, it is specifically thought for educators, and does not require any programming skills. Besides of providing a visual representation development interface, it facilitates libraries of graphical elements. As a result, it enables educators to create their games in an autonomous way, without requiring the help of any designer. In addition, eAdventure allows for an easy integration of the games produced in the classroom, by requiring few technical equipment and procedures. Besides, eAdventure games have been previously used successfully in actual educational contexts (Moreno-Ger et al., 2010).

For these reasons, I selected the eAdventure platform for the purpose of my research. Nevertheless, eAdventure does not provide any detailed methodology for guiding educators in the game design process. Furthermore, the platform does not supply any tool for imagining fun and engaging scenarios. Consequently, it is necessary to define a methodology for guiding teachers in the process of educational game design. In this objective, Section 2.3 looks at literature related to the design of LGs.

2.2.5. Some examples of application of GBL in Spanish schools

As my research was conducted with Spanish primary and secondary schools, it seems relevant to provide a series of examples of the application of GBL methodologies in such contexts.

First of all, I cite the work conducted by in the F9 group[51] (directed by Begoña Gros), a network of primary and secondary school teachers created in 1995, which aimed to take advantage of the educational potential of digital games and enhance digital literacy in students. Teachers from the group have been using different games (e.g. *Lemmings*, and *The Incredible Machine*) in the context of various educational activities and disciplines, such as mathematics, language, and social sciences. They also analysed numerous digital games according to their pedagogical potential, and created a classification grid[52] which enable to catalogue and select digital games according to particular educational criteria.

In addition, the educational researcher José-Luis Rodríguez Illera (2005) presented an interactive role-playing game which provided teenagers with information related to AIDS disease and its prevention. It used video stories and gave players the opportunity to construct different narratives by choosing between behaviours alternatives. The game relied on three fundamental educational principles, i.e. the individual construction of meaning, the situated character of cognition and learning, and the playing environment as a construction of the player's identity. Although the author did not report any school implementation, the results of a user test revealed a high approval rating, and respondents could easily identify with the role play.

Furthermore, I outline the project *Personatges en Joc*[53] (Characters in Play), a collection of LGs aiming to teach primary school students about famous characters in the history of science and technology of Catalonia. The collection is the result of a collaboration between the Secretary of Universities and Research of the Generalitat de Catalunya and the Polytechnic University of Catalonia (UPC). Among other LGs of the collection, *Monturiol el joc* aims to teach students from 10 to 12 about the life and work of Narcís Monturiol, the inventor of the first submarine. In the context of a case study (Espinosa, Gómez and Albajes, 2011), the game was tested in four schools of the area of Barcelona. Results highlighted that students showed a high degree of attention and a positive attitude, both during the game and the activities performed around it. Furthermore, the study demonstrated that 45% of the children learnt about new concepts related to the life of the inventor.

Students from the La Salle Ramon Llull University in Barcelona published two different LGs to the Cure4Kids e-Health challenge 2010[54]. The first one, *Yummy Tricks*, aims to teach students from 7 to 10 about healthy eating habits (Inglés-Camats, 2012). It consists of a series of mini-games, each of them revealing a trick, or lesson, related to the distinction between groups of foods in the food pyramid. Preliminary results highlight students' positive engagement with the LG and the achievement of the planned learning outcomes. The second LG, *Glooveth*, enables students from 6 to 12 to learn about healthy habits through a gaming experience enhanced by virtual reality peripheral, i.e. two interaction gloves (Macías, Moreno, Montserrat Presno, García, & Forrest, 2012).

[51] www.xtec.cat/~abernat/

[52] www.xtec.cat/~abernat/castellano/justific.htm

[53] www.personatgesenjoc.cat/

[54] www.cure4kids.org/wordpress/challenge/

The GTI research group[55] (Interactive Technologies Group, University Pompeu Fabra, Barcelona) developed *El Joc de les Torres*, a LG for smartphones aimed to discover the historical heritage of the city of L'Hospitalet in situ. The game was designed in collaboration with seven teachers. It was presented on March 20th, 2013, and applied in the context of a first pilot[56].

Furthermore, I highlight other educational projects related to games, like *Scratch a l'Escola Projecte*[57], in which students of 4th grade design their own games using the Scratch[58] application, an interactive authoring tool which enables children, through a visual programming language, to create their own interactive stories, animations, games, music, and art. Finally, the GIPI research group[59] (University of Alcalá de Henares), together with Electronics Arts, developed the project *Aprende y Juega con EA*[60], which studies the educational application of mainstream games, such as *The Sims*[61] and *Fifa*. The project aims to clarify students' attitudes towards about digital games, identify the educational value of commercial games, find appropriate ways to integrate them in the classroom, and analyse their potential impact that for solving learning problems and promote collaboration between students.

This series of examples, without being exhaustive, highlights the efforts made within various research projects to enhance the use of GBL in Spanish school contexts. Nevertheless, such methodologies are not widespread in common educational settings yet.

2.3. The design of LGs

After having defined the focus of the study regarding GBL (i.e. the design of LGs by teachers), it seems relevant to review the literature related to the design of LGs. To do so, I first broadly review the field of game design, as explored by game studies. Afterwards, I narrow down my exploration to the literature related to educational game design, and to the role of educators in the design process. Finally, I describe some important aspects to the design and evaluation of LGs.

2.3.1. Game designers' frameworks

As defined by Salen and Zimmerman (2004), "game design is the process by which a game designer creates a game, to be encountered by a player, from which meaningful play emerges" (p. 80). Game studies provide numerous models proposed by game designers, on the basis of their professional practice.

Djaouti, Álvarez and Jessel (2010) reviewed 36 recent publications related to game design. The authors distinguish between different categories of game design methodologies. For example, some models concentrate on the relationship between the game and the player. In this category, the MDA framework (Hunicke, LeBlanc & Zubek, 2004) divides the relationship game-player into three

[55] http://gti.upf.edu/

[56] http://daviniahl.wordpress.com/

[57] http://scratch.escolaprojecte.cat/home

[58] http://scratch.mit.edu

[59] http://uah-gipi.org/

[60] www.aprendeyjuegaconea.com/

[61] http://thesims.com

different levels, i.e. mechanics (the formal system of rules and mathematics behind the game, including its different components and their relationships), dynamics (the behaviours of the mechanics that arise when the player plays the game) and aesthetics (the emotional responses of the player). In addition, Salen and Zimmerman (2004) propose to analyse and create games by applying three different *game design schemas*, i.e. rules (a formal schema which focuses on the intrinsic mathematical structures of games), play (an experiential schema which emphasizes players' interaction with the game and other players) and culture (a contextual schema which highlights the cultural settings into which any game is embedded).

In contrast, Djaouti et al. (2010) highlight several models which concentrate on the design process and describe it in terms of succeeding stages (e.g. Adams & Rollings, 2007; Crawford, 1984; Fullerton, 2008). I focus on these models, which are more relevant for the purpose of my research. Indeed, they present an interesting relationship with Amabile's model of creative process (Amabile, 1983, 1996), and enable to establish a parallel between GBL and creativity. The next paragraphs describe some of the most recognized stage-based models.

Crawford (1984) proposed a formal game design sequence, which he describes as a set of suggested habits that game designers may integrate in their practices:

- *Choose a game and a topic:* this stage consists of defining the fantasies and types of emotions transmitted by the game, as well as the goal to be achieved by the player. On this basis, it is necessary to select a topic, an environment, and to design a set of conditions and events.
- *Research and preparation:* this stage is about immersing in the topic, by reading, researching understanding the mechanics of the environment that the game attempts to represent.
- *Design phase:* it refers to creating, in a simultaneous manner, the outlines of three interdependent structures, namely the I/O structure (the system that communicates information between the computer and the player), the game structure (the internal architecture of causal relationships that define the obstacles the player must overcome), and the program structure (the organization of code and data that make up the entire program). Furthermore, this stage involves an evaluation phase, which examines the quality of these three structures. If the evaluation is not conclusive, the design process starts again, or the project is aborted.
- *Pre-programming phase:* it refers to the preparation of the game documentation, i.e. transferring the design results from the previous stage to paper.
- *Programming phase:* it consists of programming the game on an informatics support.
- *Play-testing phase:* it aims to gather information used to correct design and programming problems. The author highlights two forms of play-testing: the first is done by the designer in order to repair bugs, while the second form comes later when the game is given to other play-testers.
- *Post-mortem:* finally, it is important to listen to the critics made to the game by experts and players, so to take them into account for next games.

In addition, Adams and Rollings (2007) propose an iterative process organized around three stages:

- *Concept stage*: it consists of creating the foundations of the game, by building a general idea, defining an audience, determining the player's role, and fulfilling the dream (i.e. considering ways to fulfil the player's dream and determining the essence of the experience).
- *Elaboration stage:* it refers to moving the design work from the general to the specific, and from the theoretical to the concrete. This is done by defining the primary gameplay mode (e.g. the perspective in which the player views the game world), designing the protagonist and the game world (i.e. where the game takes place), creating the core mechanics and writing the story. Furthermore, this stage involves building, testing, and iterating. Indeed, games should be prototyped before release, and tested at every step of the design process.
- *The tuning stage:* it consists of making small adjustments to the levels and core mechanics in order to improve the game.

Finally, the game designer Tracy Fullerton (2008) proposes a formal model of the game design process, using the six following stages:

- *Conceptualization:* as Adams' concept stage, it consists of coming up with the game concept, by brainstorming, editing and refining ideas. Afterwards, these ideas are tuned into a game, through the definition of formal elements (i.e. conflict, rules, actions of the players, target audience, supporting platform, etc.) and the design of storyboards.
- *Prototyping:* this stage consists of creating a working model of the idea, which enables to test its feasibility and operate eventual improvements. Usually, designers create physical prototypes, which enable them to focus on gameplay rather than on technology.
- *Digital prototyping:* after physical prototyping, this stage consists of elaborating a functional prototype of the game.
- *Play-testing:* it refers to evaluating and revising the game elements in an iterative manner, to gain an insight into whether or not the game is achieving player experience goals. Play-testing can be done through different practices, such as self-testing, testing with the target audience and group testing.
- *Functionality, completeness and balance:* this stage aims to ensure that gameplay is functional, complete, and balanced. Functionality ensures that the system is set to the point where someone who knows nothing about the game can play it. Internal completeness refers to avoiding loopholes and dead ends. Finally, balance refers to ensuring that the game meets the goals set for the player experience.
- *Fun and accessibility:* this last stage looks at fun elements (e.g. challenge, play, and story) which engage players with the formal system and keep them emotionally involved in the game, as well as the accessibility of the game for intended players.

In addition, the author provides a set of concrete phases for a game project development, including (a) *concept phase* (creating a concept document, project plan, budget and contract); (b) *preproduction* (verifying the feasibility of the idea by creating one playable level or environment of the game); (c) *production* (executing the vision and plan established in the previous stage, by building the audio-visual resources and programing); (d) *quality assurance* (polishing the game); and (e) *maintenance* (monitoring user feedback when the game is shipped and continuing fixing bugs).

Table 1 compares the three stage-based models above mentioned.

CRAWFORD (1984)	FULLERTON (2008)	ADAMS AND ROLLINGS (2007)
Choose a goal and a topic	Conceptualization	Concept stage
Research and preparation		
Design		Elaboration stage
	Prototyping	
	Digital prototyping	
Pre-programming		
Programming		
Play-testing	Play-testing	
	Functionality, completeness and balance	Tuning stage
	Fun and accessibility	
Post-mortem		

Table 1: Synthesis of the different stage-based game design models

As shown in Table 1, the three models present distinct models of stages, which makes it difficult to establish a general process of game design. Nevertheless, it is possible to identify a number of aspects which are recurrent in the different models. First, all authors highlight a concept phase (which correspond to the first two stages of Crawford's model) which sets the foundations of the game. Second, all models include play-testing activities with the target audience. Furthermore, Fullerton's and Adams and Rollings' models include prototyping activities which consist of testing feasibility. They also highlight stages during which small adjustments are made to refine the game.

In addition, it is worth mentioning that all models regard the game design process according to an iterative approach, where the basic activities are repeated until reaching a definitive solution. Indeed, Adams and Rollings (2007) recommend building, testing and iterating. In addition, Fullerton (2008) argues, as a key condition of het play-centric approach, that ideas should be prototyped and play-tested early in the design process, so to operate the necessary adjustments all along the design process. This iterative aspect of game design also appears in Salen and Zimmerman's approach (Salen & Zimmerman, 2004). Indeed, the authors propose a methodology through which the game is tested since the first stages (not later than 20 per cent of the way into a project schedule), thus involving end-users all along the design process. To the authors, iterative design is critical, as it is not possible to anticipate play in advance.

Finally, design documents (i.e. storyboards and other game documentation) appeared as common element in all models. Particularly, Adams and Rollings (2007) recommend producing three different documents, i.e. a *high concept* document, which serves as a marketing tool, a *game treatment* document, which outlines development requirements and a timeline, and a *game script*, which contains the game plot, decision trees, and gameplay elements.

2.3.2. Educational game design aspects

After having reviewed literature related to game design, I narrow down to the focus of my research, i.e. educational game design. Numerous authors attempted to provide methodologies for the design of LGs, either on the form of guidelines, sequences of stages, or models focusing on the different areas of action and skills involved by the design process. In this section, I highlight a range of models which are useful to set a background for educational game design in the context of my research.

a) Learning game design principles (Klopfer et al., 2009)

Klopfer et al. (2009) propose a series of principles for educational game design. Among others, the authors recommend choosing wisely (games are a powerful medium, but are not appropriate for all audiences, topics and contexts), think small (the scale and complexity of games should be determined according to the particular learning goals and context. In some cases, a small casual game is the right option), not confuse LGs with commercial games (LGs do not need to equal the high standard of commercial games in terms of budget and aesthetics), put learning and game play first (pedagogical and gaming aspects should be considered in a simultaneous and flexible manner, to allow for iteration between the two), leverage soft skills (besides of specific contents, games should promote 21st century skills such as problem solving, collaboration and analytical thinking), define the learning goals (clearly define goals a priori enable to show measurable gains in learning), and consider the context of use of the games (i.e. people who play them, instructors who shape the experience, surrounding activities, place where they are played, etc.).

b) An experiential gaming model (Kiili, 2005)

Kiili (2005) proposed an experiential gaming model, which aims to help designers understanding the learning mechanisms in games. The model includes two cycles, i.e. gaming and design. The first one describes the gaming and learning processes which characterise games. It highlight the importance of taking into account several flow antecedents, i.e. balanced challenges, clear goals, unambiguous feedback, a sense of control, playability, focused attention, and a frame story. The second one describes the main phases which compose the game design process: first, a *needs analysis* enables to identify the needs of learners. Afterwards, in a *preinventive phase*, designers try to develop creative solutions. These solutions are then elaborated according to flow antecedents, contextual factors and instructional design principles, during a *solution generation phase*. Solutions are implemented with players through prototyping so to engage end-users in the design process. Finally, a *reflective evaluation* enables to analyse the game elements and the experience of players.

This model brings valuable considerations to integrate both flow elements and pedagogical aspects. Nevertheless, the design cycle presents rather generic stages which do not concretely indicate how to integrate pedagogical aspects in the design process.

c) Stages of the educational game design process (Morales, 2012)

Based on models from different disciplines (i.e. game studies, design studies and pedagogical theories of learning), the design researcher Joan Morales (2012) adapts the phases from the mainly accepted frameworks of design process to the particular context of educational game design:

- In the *informative and analytic* phase, he recommends defining the objectives of the project through an initial document. This document defines the general pedagogical objectives of the game, the profile of the group of users, and the context of use.
- At the *establishment of the design hypothesis* phase, he advices experimenting and conceptualizing the game ideas, during which several hypotheses are considered and tested to arrive to an adequate solution. The author recommends writing down these hypotheses in a design document, which is similar to the high concept document, as described by Adams and Rollings (2007), i.e. a short document which includes a description of the main concept of the game, a list of key-content which outline the idea of the game, a general view on the project's characteristics, and a description of the pedagogical aspects of the game.
- During *synthesis phase and representation of solutions*, the author proposes to select and develop one of the hypotheses considered in the previous phase. The author recommends preparing a document called game treatment (Adams & Rollings, 2007), which describes the project's details in a definitive manner, including a general vision of the game, the main aspects of technology and audio-visual production, a first approach to production details, and a description of the game world. At the pedagogical level, consists of defining the way pedagogical objectives and resources will be integrated in the game. During this phase, initial versions of the software are tested within the work team.
- Finally, at *direction of production,* he suggests to define the design solutions which will guide the production phase. The author recommends elaborating an exhaustive document, similar to the design script (Adams & Rollings, 2007). It includes the creative, conceptual and functional aspects, including a continuous cycle of testing beta versions with end-users, in order to obtain feedback on their experience.

This model brings a clear set of stages which detail the integration of pedagogical aspects in the design of games, from the perspective of the design discipline. It is now necessary to elicit the different areas of actions and roles involved in the design process.

d) Skills and areas of action required for the creation of a LG

Morales (2012) describes three areas of action at stake during the design of LGs:

- *The global design of the playing and learning experience:* this area includes the design of the experiential aspects of the game, which will enable the player to achieve the planned gaming and educational objectives. In a holistic manner, the designer should look at the game world and the interaction system, focusing on the player's experience and satisfaction.
- *The art direction of the game world:* this refers to shaping the game world through the space, characters, and game tokens. The work involves conceptualizing the game world, design characters, objects and scenes. It also includes the tasks of graphic design, composition and edition of audio elements.
- *The design of the rules and the interaction system:* this area consists of designing interaction experiences between the player and the game, through a system of rules which corresponds to the pedagogical strategies and the symbolic framework. These patterns should be designed in

order to facilitate an experience which is both entertaining and efficient from the learning perspective.

In addition, Whitton (2010) identified a range of skills and expertise that are required to create an LG from scratch, i.e. (a) the subject expert (the one who knows about the domain covered in the game, has experience teaching it, knows what the pedagogical objectives are, and what areas the students are likely to find difficult), (b) the educationalist (the one who understands GBL and learning in general, the age group and backgrounds of the learners, and the design of effective digital games for education), (c) the game designer (the one with an understanding of the elements required to make games fun and engaging), (d) the programmer (the one who can use the development software to create the game as specified by the other team members), (e) the interaction designer (the one with knowledge on user-centred design, so to ensure that the game is as usable as possible), (f) the graphic designer (the one with graphic design skills, to ensure that the game seems professional), and (g) the writer (a dedicated writer may be a useful role in the team). To the author, a single individual would be very talented to possess all of these skills, so it is likely to work in a collaborative manner.

This short review set a background for educational game design. It first enabled to appreciate the importance of taking into account several flow antecedents in the design process (Kiili, 2005). It also provided some concrete stages of action (Morales, 2012), and highlighted the different roles and expertise required to the design of a LG (Morales, 2012; Whitton, 2010).

2.3.3. Teachers as game designers: a literature gap

After having highlighted different frameworks related to the design of LGs, I concentrate on the role of educators in the design process. Nevertheless, while reviewing recent studies, I could observe a literature gap regarding practices of educational game design by teachers.

A wide range of GBL projects have been developed with the partial involvement of instructors in the game design process. For example, the LG *Donjons & Radon* involved the participation of physics and chemistry teachers in defining teaching models and evaluating of the game prototypes (Marne, Wisdom, Huynh-Kim-Bang, & Labat, 2012).

In addition, the <e-UCM> research group reported different cases in which educators participated in the design of LGs with eAdventure, i.e. participating in decisions related to game dynamics (Moreno-Ger et al., 2010), providing advice and feedback on the game content and flow (Marchiori, Torrente, del Blanco, Moreno-Ger, Sancho, & Fernández-Manjón, 2012), as well as collaborating in writing storyboards (Moreno-Ger, Blesius, Currier, Sierra, & Fernández-Manjón, 2007). Furthermore, Marchiori et al. (2012) reported the development of a LG based on the collaboration of two domain experts (i.e. experienced first-response emergency doctors), an educational expert and a team of computer science engineers. However, no study reports the design of eAdventure LGs in which teachers have a protagonist role.

Some basic authoring applications allow for the design of educational ICT-based activities by teachers. For example, Tarraga Mínguez (2012) highlights two authoring tools. The first one, *Jclic*, is a famous application which is widely used in Spanish educational centres. It enables teachers to design

17 different types of activities, some of them game-like (e.g. memory games, puzzles and crosswords). The second one, EdiLim, is an editor of interactive books. It allows for the creation of web pages including different activities, such as multiple choice questions, classifications of images and texts, and dictations. These applications enable to easily design a wide range of game-like activities, and can take part of the daily practices of pre-school and primary education teachers. However, these activities cannot be considered as proper games.

2.3.4. Important aspects in the design and evaluation of LGs

On the basis of an analysis of good practices in GBL performed in the context of the ProActive project (Annex 1.1), and by exploring recent literature, I extracted a set of important aspects to be considered for the design and evaluation of LGs. These aspects can be classified in three different categories, namely gaming, pedagogical and usability aspects.

a) Gaming aspects

This category includes the different elements of games which allow for entertainment. It corresponds with the concept of *gameplay*, which Perrotta et al. (2013) define as "the treatment of topics and ideas as rules, actions, decisions and consequences" (p. 2). Many of the elements pertaining to this category are flow antecedents.

Clarity of intermediary and final goals

Games should present well-defined and meaningful goals which help players to focus on what they have to do, and how to get closer to their objective (Kiili, 2005; Klopfer et al., 2009; Malone & Lepper, 1987; Perrotta et al., 2013; Ulicsak & Williamson, 2011). To the computer scientists Penelope Sweetser and Peta Wyeth (2005), goals should be provided to players at appropriate times. Indeed, they should present an overriding goal early in the game, as well as intermediate goals which guide players at different moments. Finally, Gee (2009) adds that games should present goals to which players are emotionally attached.

Balance of difficulty

Good games include challenges that match the level of skills of players (Kiili, 2005; Shute & Ke, 2012; Sweetser and Wyeth, 2005). Indeed, the goals posed by the games should be achievable, but at the same time, stretch learners' abilities (Ulicsak & Williamson, 2011). This balance is similar to Vigotsky's ZPD, in the sense that games should provide an appropriate guidance to help players meet the next challenge (McClarty et al., 2012).

Regarding the personalization of challenge, Malone and Lepper (1987) argue that players should be able to vary the difficulty of the game. In addition, many authors stress that the level of difficulty should increase gradually, through progressive levels, so that players can perceive their advancement (Ulicsak & Williamson, 2011).

Clarity and constancy of feedback

Good games provide immediate and unambiguous feedback to players' actions (Kiili, 2005). Indeed, players learn best when they receive feedback to identify and evaluate their mistakes (Gee, 2009).

Furthermore, it is important that they give learners timely information regarding their progress (Shute & Ke, 2012; Ulicsak & Williamson, 2011), as guidance to facilitate and correct their performance (Perrotta et al., 2013). Hence, feedback about players' performance should be constant along the game (Malone & Lepper, 1987; Sweetser & Wyeth, 2005).

Furthermore, the feedback system may reward learners with prizes, according to their achievements, matching their increasing level of skills (Ulicsak & Williamson, 2011).

Clarity and consistence of rules

Games should present clear and consistent rules so that players know how to play them (Rapeepisarn et al., 2008). These conditions and restrictions direct their actions (Sweetser & Wyeth, 2005; Ulicsak & Williamson, 2011). As mentioned by Perrotta et al. (2013), rules can be more or less complex depending on the choices they elicit and the related consequences. They can be either binary (i.e. if, then), or multifaceted (i.e. involving a broad range of decision making processes).

Presence of elements which facilitate the player's immersion

Last, but not least, games should facilitate players' immersion, that is, their emotional investment, engagement and absorption (Sweetser & Wyeth, 2005). The authors define immersion as a "deep but effortless involvement, reduced concern for self and sense of time entertainment to the user" (p. 4).

Immersion can be achieved through different ways, i.e. an imaginary environment, characters or story, engaging audio-visual effects which affect players' senses, elements of novelty and surprise, and elements of relevance and interest for learners (Sweetser & Wyeth, 2005; Ulicsak & Williamson, 2011). Furthermore, players are more motivated when they feel a personal attachment to the goal (Gee, 2009).

b) Pedagogical aspects

In order to reach a balance between entertainment and educational objectives, it is critical to consider, besides of gaming aspects, some pedagogical considerations so to enable to reach the pedagogical objectives planned and to achieve rich learning experiences.

Clarity of the pedagogical objectives

Klopfer et al. (2009) highlight the importance of defining clear learning goals, in order to build a consistent body of knowledge and show measurable gains in learning. Furthermore, players should be introduced to the learning goals posed by the game (Ulicsak, 2010).

Connection to the curriculum and associated competences

As argued by the GBL researchers Sara de Freitas and Martin Oliver (2006), the ability of the game to support curricular goals is critical in formal education contexts. Hence, the goals and content of the LGs should show a direct link to the formal curriculum (Kirriemuir & McFarlane, 2004; Ulicsak & Williamson, 2011; Whitton, 2010). Furthermore, Ulicsak & Williamson (2011) stress the importance of setting a lesson plan which clarifies how the game is embedded in the overall curriculum.

Alignment of game play and pedagogical objectives

To Whitton (2010), it is critical to make sure that the goals of the game support the pedagogical objectives. The game mechanics and activities should directly relate to the learning goals (Ulicsak, 2010). Mapping learning and gaming outcomes is determinant for ensuring the educational potential of the game. Hence, it is important to first start with clearly defining the pedagogical objectives, so that they can form part of a design specification for the game (Whitton, 2010).

Appropriateness of the pedagogical objectives to the profile of the group of students

This criterion is closely related the concept of challenge. Indeed, it refers to the adaptation and relevance of the games' materials and methods to learners' needs, learning styles, and background, i.e. their age, language, experience, prior and knowledge (de Freitas & Oliver, 2006; Ulicsak, 2010).

Planning of complementary activities which support learning with games

As mentioned by Whitton (2010), LGs should not be simply regarded as stand-alone activities. Rather, they should be thought as part of a blended learning approach, i.e. in relation to other activities that surround them (Ulicsak, 2010). In order to situate the LGs within a meaningful learning context, additional learning activities offer opportunities for stimulating reflection on the game, which is often not an intrinsic part of the game itself (Whitton, 2010).

These activities should include briefing (to help students understand the purpose of the game), debriefing and reflective activities during and after the game, to reinforce the learning outcomes (de Freitas & Oliver, 2006; Whitton, 2010). These pre- and post-game discussions can facilitate the transfer of knowledge and lesson learnt from the game to the real world and to other learning contexts (Ke, 2009; McClarty et al., 2012).

As mentioned by Gros (2007), these activities determine the development of the game. Hence, it is critical to determine the context of use of the game, i.e. how the game is contextualized, the development of the sessions, as well as the type of interaction among students and teachers (role of the teacher, competition and collaboration aspects).

Detailed planning of students' pedagogical evaluation methodology

The open-ended nature of game activities makes assessment of learning difficult (Ulicsak, 2010). However, teachers have to make sure that students achieve the planned pedagogical objectives, and that the acquired skills and knowledge are transferable outside of the game.

Assessment strategies can be comprised inside (e.g. scoring mechanisms, number of correct answers, time taken to complete the game) or outside the game (Ulicsak, 2010). Whitton (2010) provides some examples of assessments strategies associated to GBL, e.g. reflective reports on actions taken and decisions made in the game, presentations using roles from the game, creation of artifacts which extend the action in the game (e.g. posters and digital videos), and discussions related to the game on collaborative websites (e.g. blogs and wikis).

In any case, it is critical to align pedagogical objectives, gaming activities and assessment activities (Whitton, 2010). The author recommends not relating performance in the game to performance in the overall assessment. Indeed, it is important that students feel free to experiment and make mistakes in the game.

Planning of the necessary resources to conduct the learning activity

It is important to consider the environmental settings associated with the use of the game and the resources available (de Freitas & Oliver, 2006; Whitton, 2010), i.e. the place in which teaching and learning take place, the time available for using the game and complementary activities, the equipment available, the access to technology, the types of hardware and software required to run the game. Furthermore, it is critical to ensure that access is equitable for all students, and that all machines are capable of running the software planned to be used. Finally, there might be institutional barriers to using technology (e.g. firewalls) that it is important to take into account (Whitton, 2010).

c) Usability aspects

To Morales (2012), the usability dimension is problematic from the point of view of games, as the ultimate aim of games is to provide a challenging experience, and in the case of educational games, pedagogical objectives must also be achieved. Consequently, he suggested that usability principles must be adapted with playability and learning principles, in order to provide a satisfactory gaming and learning experience. In this dissertation, I use the term usability to refer to the functionality of the user interface and its potential to provide a pleasant experience without any confusion.

Easiness of use

The gaming software should be easy to learn, interact with and navigate. Hence, controls should be logical and consistent along the game (Whitton, 2010). Players should feel a sense of control over the interface, the characters or units, and their movements and interactions in the game world (Sweetser & Wyeth, 2005).

Accessibility

As mentioned by Whitton (2010), "accessibility refers to the way in which all students, but in particular those with disabilities, can gain access to and use the gaming environment provided" (p. 161). It is important to consider the range of accessibility issues that students may have with LGs, i.e. limitations because of disabilities, access to equipment, or lack of previous experience using a particular gaming genre. The author provides some recommendations to reach this criterion, such as making sure that textual equivalents are provided for all auditory and visual content, and the ability to resize text and customize colours.

2.3.5. Evaluation strategies of LGs

The last section extracted a set of important aspects for the design and evaluation of LGs. Here I explore some concrete strategies (i.e. techniques and tools) to evaluate these aspects.

First, Whitton (2010) mentions different techniques useful for carrying out evaluations of LGs:

- *Expert walkthroughs:* this procedure consists of asking someone with a background and expertise in interface design or game design to play the game and provide feedback. It can be useful for highlighting problematic issues and getting advice on how to solve them.
- *Think-aloud walkthroughs:* this technic consists of asking users to play the game and talk through what they are thinking, so to observe how their interactions with the game relate to their thinking process. It enables to identify playability or usability issues, as well as to evaluate whether students learn as expected.
- *Observations:* it consists of watching people play the game, by observing how they approach tasks and interact with the system. Observations provide insights about what works well and where problems exist.
- *Interviews and focus groups:* they consist of talking to individuals or groups about their experiences when using the game. They provide good opportunities to look for creative solutions for problems and to get additional ideas from users.

In addition, Sweetser and Wyeth (2005) have created *GameFlow*, a model of evaluation of games based on the concept of flow, as defined by Csikszentmihalyi. It aims to analyse players' level of enjoyment in a game. The model consists of an evaluation checklist which includes different factors in games that can enhance the occurrence of flow experience (e.g. immersion, clarity of goal, autonomy, feedback, concentration, and challenge). As stated by Fu, Su and Yu (2009), *GameFlow* is considered as a relevant tool for evaluating games. Indeed, the model was presented at the ACE'07 International Conference and is recognized by many authors in game studies. With the aim to evaluate LGs, Fu, Su and Yu (2009) adapted *GameFlow* into a questionnaire. Furthermore, they added the factor of knowledge improvement, in order to take the learning dimension into account. The result consists of a validated scale called *EGameFlow*.

Summary of the chapter

In this chapter, I explored two areas of research, i.e. creativity in education, and GBL. Through a review of literature, I could define a model of analysis for exploring creativity in the particular context of my study. Furthermore, I extracted a set of key-characteristics of creative pedagogies. I then explored the potential of digital games for enhancing these different characteristics, and could validate a clear relationship between GBL and creative pedagogies. Afterwards, I explored the different approaches to integrate games in formal educational contexts, and selected an approach through which teacher create their own LGs, by using the eAdventure editor. Finally, I reviewed different frameworks of game design, and extracted a set of important aspects to be considered for the design and evaluation of LGs, according to three categories, i.e. gaming, pedagogical and usability aspects.

These theoretical foundations served as a basis for defining the conceptual framework of my research (as described in the next chapter), i.e. the definition of a model of stages for creative educational game design especially adapted to teachers, and the dimensions to be analysed in the research.

CHAPTER 3
Conceptual framework

Introduction

This chapter aims to define the conceptual framework of the study. To do so, I selected, from the literature review performed in last chapter, the theoretical approaches on GBL and creativity that are relevant to my research. On this basis, and according to the results of an exploratory study conducted with primary and secondary school teachers, I elaborated a model of stages for creative educational game design specially adapted to teachers. Finally, I defined the dimensions to be analysed in the research. Figure 8 resumes the process followed in order to define the conceptual framework.

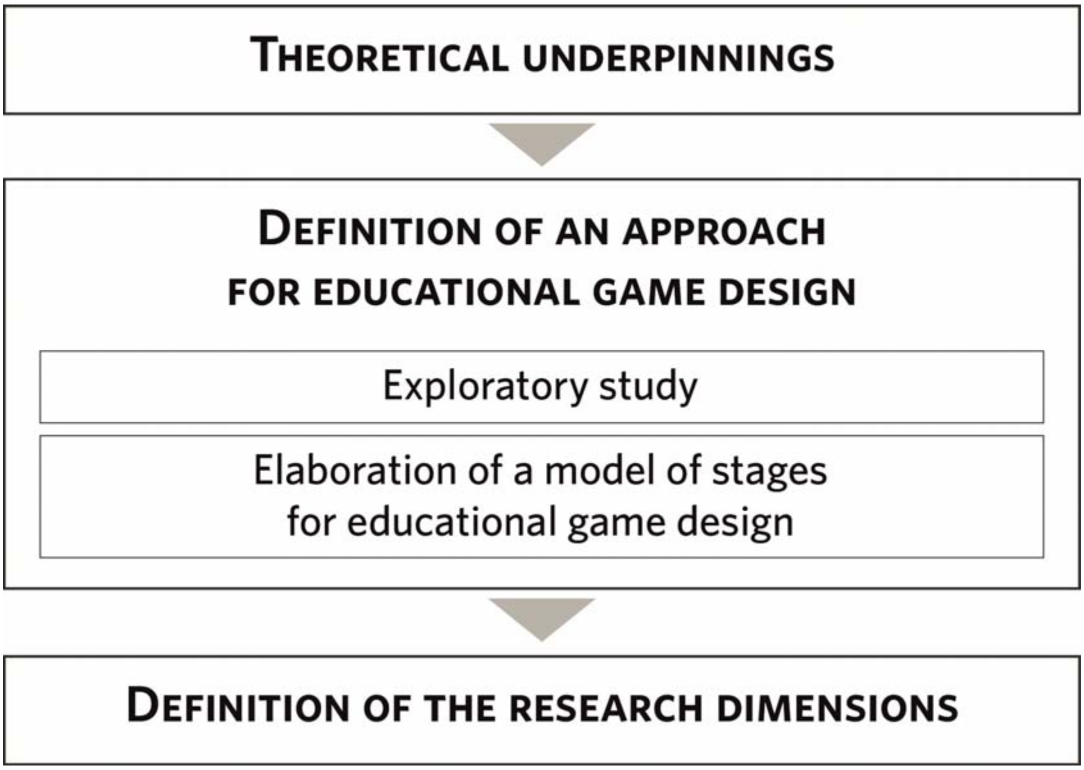

Figure 8: Process of definition of the conceptual framework

The chapter is organized in the following manner: first, it resumes the theoretical approaches chosen from the literature review. Afterwards, it describes the procedures and results of the exploratory study, as well as presents the stages for educational game design defined accordingly. Finally, it defines the different dimensions to be examined through the study.

1. Theoretical underpinnings

The literature review performed in Chapter 2 highlighted different approaches to creativity and GBL. According to the object of my research, I selected some of these approaches. First, I chose an appropriate paradigm, definition and model of analysis to explore the creativity phenomenon. Second, I set my position towards the place of creativity in educational contexts. On this basis, I set a rationale for choosing GBL as pedagogical solution to foster creative pedagogies. I selected an appropriate approach for integrating GBL in the classroom, i.e. the creation of LGs by teachers. To support this approach, I chose an adapted game editor and selected relevant literature to define stages for educational game design adapted to teachers. Finally, I identified the criteria to evaluate the quality of LGs designed by teachers.

The present section resumes the choices made regarding the literature review of creativity and GBL, which constitute the theoretical foundations of my research.

1.1. Conception of creativity adopted in the study

Creativity has been explored through different paradigms, including pragmatic, psychodynamic, psychometric, cognitive and evolutionary approaches. As opposed to these linear views, I considered multidimensional approaches to look at creativity in my research (Amabile, 1983, 1996; Csikszentmihalyi, 1988, 1996; Sternberg & Lubart, 1991, 1995). Indeed, I aimed to explore the complexity of this phenomenon as a system, in a holistic manner, and to take into account the various dimensions of its implication on educational settings.

In this line, I selected the definition of creativity provided by Plucker et al. (2004), which puts forward the interaction among different dimensions: "creativity is the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as determined within a social context" (p. 90).

In order to study creativity as a multi-dimensional construct, I chose to apply Rhodes' four Ps model (1961) to my research context. This model enables to explore, in a comprehensive manner, the interactions among the different components of creativity, namely process (the stages involved in the creation of ideas or outcomes), person (the individual characteristics of the creators), press (the external environment in which creativity happens), and product (the tangible or intangible outcomes of the creative process). The next paragraphs outline the theoretical choices I made to explore each of these components.

a) Process dimension

In order to analyse this dimension, I used the stages identified in Amabile's componential model (Amabile, 1983, 1996), a validated theory which establishes a five stages sequence:

- *Problem or task identification:* the individual becomes aware of the task to undertake or the problem to solve;
- *Preparation:* it consists of gathering information in order to undertake the task;
- *Response generation:* it refers to producing candidate solutions or response possibilities;
- *Response validation:* the individual evaluates the response possibility;
- *Outcome:* the response is communicated and the outcome of the process is evaluated.

Following a multidimensional approach, this model considers the influences of the other dimensions of creativity on each stage.

b) Person dimension

I studied this dimension by looking at the intra-individual components that influence creativity, as identified by Amabile (1983, 1996):

- *Domain-relevant skills:* the individual's knowledge and skills in the particular domain, i.e. expertise, technical skills, and special domain-relevant talent.
- *Task motivation:* what the individual will do and how it will be done, given that people are more creative when they are motivated by the task itself (intrinsic motivators) rather than by external pressures (extrinsic motivators).
- *Creativity-relevant processes:* individuals' personality characteristics, cognitive styles and work habits that promote creativity in any domain, including an appropriate cognitive style (keeping options open, suspending judgement, and tolerating ambiguity), an implicit or explicit knowledge of heuristics for generating novel ideas (e.g. using analogies), and an appropriate work style (e.g. the ability to work during prolonged periods).

Furthermore, I considered the different elements of flow (Csikszentmihalyi, 1990, 1996) in order study motivation, as well as other traits of creative people highlighted by the author, i.e. passion, interest in the domain, access to the domain and to the field. Finally, I took into account some of the individual resources suggested in the investment theory (Sternberg & Lubart, 1991, 1995), i.e. willingness to overcome obstacles, to take sensible risks, and to tolerate ambiguity.

c) Press dimension

My study explored this dimension by looking at the influences exerted by the different aspects of teachers' environment:

- *Resources available* (Amabile & Gryskiewicz, 1989): the different resources available to teachers, i.e. time, material resources, and the digital environment which supported the design process.
- *Social environment* (Amabile, 1983, 1999): the different actors which composed teachers' social environment, e.g. students, colleagues and the educational centre.
- *Collaborative design processes:* the conditions for collaborative creativity. To explore this aspect, I analysed the following: (a) group members, i.e. members' profiles (John-Steiner, 2000), and shared history (Eteläpelto & Lahti, 2008; Sawyer, 2007); and (b) group processes, i.e. legislation, distribution of tasks, leadership, communication processes, relationships among group members (Eteläpelto & Lahti, 2008), and indicators of group flow (Sawyer, 2007).

d) Product dimension

Finally, I explored product creativity by assessing the usefulness and novelty of the produced outcomes (Amabile & Pillemer, 2012; Runco, 2004, 2007; Sternberg & Lubart, 1999; Villalba, 2008). To do so, I chose to take into account the view of experts in the field (Csikszentmihalyi, 1996). Regarding novelty, I preferred to give more importance to little-c (Craft, 2001) and middle-c (Moran, 2010) than to Big-C creativity, although I explored the three aspects.

Table 2 illustrates the theoretical models and components chosen in order to analyse creativity within the specific context of my study.

CREATIVITY COMPONENT	ELEMENTS STUDIED AND ASSOCIATED THEORIES
Process	Stages of the componential model of creativity (Amabile, 1983, 1996): • Problem or task identification • Preparation • Response Generation • Response Validation • Outcome
Person	Intra-individual components of the componential model of creativity (Amabile, 1983, 1996): • Task motivation • Domain-relevant skills • Creativity-relevant processes (Amabile, 1983, 1996; Csikszentmihalyi, 1990, 1996; Sternberg & Lubart, 1991, 1995)
Press	Available resources (Amabile and Gryskiewicz, 1989) • Time • Material resources • Digital environment
	Social environment (Amabile, 1983, 1996)
	Collaborative creativity (Eteläpelto & Lahti, 2008; John-Steiner, 2000; Sawyer, 2007): • Group members • Group processes
Product	Usefulness (Amabile & Pillemer, 2012; Runco, 2004, 2007; Sternberg & Lubart, 1999; Villalba, 2008)
	Novelty • Little-c (Craft, 2001) • Middle-c creativity (Moran, 2010) • Big-C creativity (Craft, 2001)

Table 2: Models and components chosen to explore creativity in the study

1.2. A focus on teachers' creativity

As agreed among recent literature, I argue that creativity is amenable to education (Craft, 2001; Esquivel, 1995; Lin, 2011). Indeed, I regard creativity as a developmental construct and a lifelong process. According to an inclusive, democratic perspective, I also argue that all individuals have the potential to be creative, and that creativity can be developed and encouraged (NACCCE, 1999; Runco & Pagnani, 2011). I tend to a little-c conceptualization, which gives priority to learners' new and personally meaningful insight in everyday activities (Craft, 2001; Runco, 2003). Furthermore, I chose a domain-wide approach, to which creativity can be fostered in all subjects (NACCCE, 1999; Runco & Pagnani, 2011).

In addition, I chose to focus my research on teachers. Indeed, they are key-players for bringing creativity to the core of formal education and for triggering students' creativity (Ferrari, Cachia, & Punie, 2009a; Beghetto, 2010).

Teachers face different institutional pressures (e.g. overloaded curriculums and standardized pedagogical objectives) which prevent them to engage in creativity-fostering behaviours (Cremin & Barnes, 2010; Ferrari et al., 2009b; Sawyer, 2012). Furthermore, there is little discussion on guidelines for adopting creative teaching practices (Lin, 2011).

As a result, the need has emerged for teachers to have models and tools for integrating creativity in their daily practices. To tackle this need, my study focuses on teachers' practices, and seeks to provide them with new pedagogical models that support the development of creative potential and academic learning.

1.3. GBL potential for enhancing creative pedagogies

When analysing recent literature (Cremin & Barnes, 2010; Cremin et al., 2009; Cremin et al., 2006; de la Torre, 1993, 2006, 2009; de la Torre & Violant, 2003; Ferrari et al., 2009b; Ofsted, 2010; Runco, 2003; Sawyer, 2012), I could extract a set of key-characteristics of creative pedagogies: (a) promoting learner-centred methodologies, (b) allowing for self-learning, (c) helping to make connections, (d) providing exploration and discovery, (e) promoting engagement, (f) providing a safe and trustful environment which encourages risk-taking behaviours, (g) adopting flexible evaluation approaches, (h) encouraging collaboration, and (i) relying on different sources, including ICT.

While exploring the potential of digital games for leaning in literature, I realized that they can promote most of the characteristics of creative pedagogies. Indeed, they connect to students' life, culture and interests (Gros, 2007, 2009; Ulicsak & Williamson, 2011); they enable learners to have an active impact on their virtual environment, and to feel a sense of agency (Aldrich, 2005; Gee, 2005); furthermore, they encourage risk-taking and exploration (Gee, 2003). Consequently, I chose GBL as pedagogical approach to foster creative teaching practices.

1.4. The choice of an approach to which teachers design their own LGs

There exist different approaches for integrating games in educational contexts. One of them, edutainment, consists of converting some educational content into game-like applications. However, in such products, game elements are added to educational content, which limits their potential for fun and engagement. Another approach consists of repurposing existing games for education. It has the advantage of providing learners with a product which has been explicitly designed for entertainment. However, literature (Gros, 2007; Kirriemuir & McFarlane, 2004; Klopfer et al., 2009; Ulicsak & Williamson, 2011) highlighted many obstacles to the adoption of this approach in the classroom context, such as the difficulty of aligning games with curriculum requirements, the negative attitudes of some parents and educators towards digital games, as well as technical and logistical issues. In order to reach a balance between fun and educational content, I chose an approach to which teachers became game designers and created games tailored to their specific educational objectives and contexts.

1.5. Selection of the eAdventure game editor

The creation of LGs involves some barriers, such as the high cost of developing games from scratch, the lack of collaboration of designers with educators, and the difficulty to access classrooms for play-testing with the target audience (Klopfer et al., 2009; Moreno-Ger et al., 2008).

In order to overcome these barriers, I chose to use the eAdventure game editor, which enables educators to create their games autonomously, without requiring any programming skills (Torrente et al., 2010). It facilitates a visual interface for game development, provides libraries of graphical elements, and requires few technical equipment and procedures. Besides, eAdventure games have been used successfully in educational contexts (Moreno-Ger, 2010).

Nevertheless, the editor does not provide any detailed framework for guiding educators in the game design process. Furthermore, the platform does not supply any tool for imagining fun and engaging scenarios. Consequently, I found it necessary to define a framework for guiding teachers in the process of educational game design.

1.6. Educational game design

Several authors from game studies (Adams & Rolling, 2007; Crawford, 1984; Fullerton, 2008) describe the game design process in terms of succeeding stages or phases. If these stages vary according to the different models, they present several aspects in common. First, they all include a concept phase which sets the foundations of the game. They also mention play-testing activities with the target audience, and often include prototyping activities which consist of testing feasibility. Furthermore, all authors argue on favour of an iterative process, through which play-testing is performed throughout the entire design process, in order to involve the end-user from early stages. Finally, design documents appeared as common element in all models.

In addition, there exist numerous frameworks specifically adapted to the design of LGs. Kiili's experiential gaming model (2005) highlights the importance of considering flow elements during the design process. Morales (2012) provided some concrete stages of action, and several authors (Morales, 2012; Whitton, 2010) highlighted the different roles and expertise required to the design of a LG. These frameworks constituted a solid background for addressing educational game design in my research.

1.7. Important aspects for the design and evaluation of LGs

On the basis of an analysis of good practices in GBL performed in the context of the ProActive project (Annex 1.1), and by exploring literature (de Freitas & Oliver, 2006; Gee, 2009; Kiili, 2005; Ke, 2009; Klopfer et al., 2009; McClarty et al., 2012; Perrotta et al., 2013; Rapeepisarn et al., 2008; Shute & Ke, 2012; Sweetser and Wyeth, 2005; Ulicsak, 2010; Ulicsak & Williamson, 2011; Whitton, 2010), I extracted a set of important aspects to be considered for the design and evaluation of LGs. They can be classified into three categories:

- *Gaming aspects:* (a) Clarity of intermediary and final goals, (b) Balance of difficulty, (c) Clarity and constancy of feedback, (d) Clarity and consistence of rules, and (e) presence of elements which facilitate the player's immersion.
- *Pedagogical aspects:* (a) clarity of the pedagogical objectives, (b) connection to the curriculum and associated competences, (c) alignment of game play and pedagogical objectives, (d) appropriateness of the pedagogical objectives to the profile of the group of students, (e) Planning of complementary activities which support learning with games, (f) detailed planning of students' pedagogical evaluation methodology, and (g) planning of the necessary resources to conduct the learning activity.
- *Usability aspects:* (a) easiness of use, and (b) accessibility.

Finally, I highlighted some concrete strategies to evaluate these aspects, such as expert walkthroughs, think aloud walkthroughs, observations, interviews (Whitton, 2010), and questionnaires aimed to analyse players' level of enjoyments (Fu, Su and Yu, 200; Sweetser and Wyeth, 2005)

The theoretical assumptions mentioned in this section served as a foundation to build an approach for educational game design specifically adapted to teachers. To do so, it was first necessary to explore teachers' current practices, interests and needs regarding GBL and creativity.

2. Definition of an approach for educational game design

This section aims to define an approach for guiding teachers in the design of LGs specially adapted to their pedagogical objectives and contexts. To do so, I first explored teachers' attitude, interests and needs towards creativity in the classroom and GBL practices. Afterwards, I defined a model of stages for creative educational game design, on the basis of the literature related to the creative process and the game design process.

2.1. An exploratory study

In order to identify teachers' interests and needs regarding creative and GBL practices, I organized, in May, 2010, two focus groups with 15 participants. They were mainly Spanish primary and secondary school teachers. Furthermore, several researchers and practitioners from the area of game development in educational contexts participated in the event. Figure 9 show pictures from the event. The participation list is available in Annex 2.1.

Figure 9: Pictures from the exploratory focus groups

The focus groups were organized in the following manner: I first presented the research approach to participants, by introducing them to GBL methodologies (i.e. the concept of games, their potential for educational purposes, and the different ways of integrating them in the classroom) and to the eAdventure editor. Furthermore, I presented them an introduction to creative teaching practices. Afterwards, I conducted a semi-structured interview which addressed the following topics:

- Teachers' habitual pedagogical practices regarding ICT and GBL;
- Their perceptions on creativity in educational contexts;
- Their interests towards GBL methodologies;
- Their needs for designing their own LGs.

The interview guide is available in Annex 2.2. The following sections describe the results of the study, following each of these topics.

2.1.1. Teachers' usual practices regarding ICT and GBL methodologies

The participating teachers regularly used ICT tools in order to enhance their classrooms activities, such as Internet search, Moodle, Powerpoint, online educational resources, blogs and e-mail. Moreover, some of them stated that they used online authoring tools in order to create their own learning applications (e.g. Jclic, presented in Chapter 2).

Generally, participating teachers had little experience using GBL practices. Indeed, they stated that they had not found any digital game adapted to their teaching settings. However, some of them had been using basic, non-digital games in their teaching practices, such as dominos, memorization games, role games (such as simulating real-life situations as in a hospital or a restaurant), and auditory discrimination games. Furthermore, teachers mentioned that they used game-like applications, e.g. Hot Potatoes[62] (a suite of six applications which enable to create interactive multiple-choice, short-answer, crossword, matching/ordering and gap-fill exercises).

[62] http://hotpot.uvic.ca/

On the other hand, two of the participating teachers had advanced knowledge in the GBL field, as they were part of the *Scratch a l'Escola* project (presented in Chapter 2), and organized workshops for creating games with Scratch application.

2.1.2. Teachers' perspectives on creativity

Teachers generally related creativity to flexibility, innovation and originality. To them, teaching in a creative way means using different strategies in a flexible way, according to the pedagogical objectives at stake. Furthermore, some teachers mentioned that teaching creatively means innovating for better learning outcomes. They found it important to include ICT resources to their methodologies, by critically selecting and adapting them according to their teaching objectives.

Most teachers stressed that there is a rather advanced technological infrastructure in Spanish schools, especially with the latest national initiative *Escuela 2.0*[63] (where 400000 children are being provided with laptops), the wide availability of digital boards in schools, and the recent creation of digital school books. Nevertheless, to teachers, these technological capabilities are not used at their maximum potential, as pedagogical approaches generally keep the same standard. Most participants expressed the need for guidance towards the innovative use of technologies, which would allow for learner-centred and playful experiences.

To teachers, creative practices promote different types of abilities in students. First, they teach them how to work in a collaborative manner. Indeed, students should be aware of others' opinions and solutions. Second, creative practices teach students how to self-evaluate and how to evaluate the work of their peers. Furthermore, teachers related teaching for creativity to teaching for change, i.e. developing students' flexibility and adaptability. Indeed, it is important that they become able to face different situations, obstacles and problems that appear in scholar and personal settings, solve daily problems, and find appropriate solutions. Finally, creative teaching practices promote originality, initiatives, risk-taking behaviours and students' self-esteem.

2.1.3. Teachers' interests and needs towards GBL

This section resumes teachers' interests towards GBL methodologies, and their opinions regarding the research approach, i.e. the design of their own LGs. The focus groups enabled to highlight some obstacles to the game design methodology, as well as to identify what teachers needed in order to overcome those obstacles.

a) Interests towards GBL methodologies

Generally, teachers considered GBL as a powerful methodology to foster creativity in the classroom and achieve rich educational objectives. Many participants shared the idea of a classroom where learning happens in more natural, playful, and student-centred way. GBL was perceived as a good way to achieve it. In fact, some teachers argued that all classroom activities should include game aspects. In contrast, others believed that methodologies should vary depending on the educational objectives to be reached, and that GBL is not appropriate for achieving some learning goals.

[63] http://www.escuela20.com

I identified several factors that stimulated teachers in using digital games in their teaching practices. The first one was their curiosity. Indeed, most of them never used games for teaching, and were curious to discover how they could be embedded in the classroom context. Second, teachers showed a high interest for discovering new ICT-based teaching methodologies and for acquiring digital skills. In addition, GBL was seen as an additional resource which could help them bring diversity and innovation into their teaching methodologies. Furthermore, teachers argued that GBL would enable them to reach different pedagogical objectives, in many curricular learning subjects, as well as promote the acquisition of transversal skills, such as reflection, linguistic and communication. Digital games integrate different multimedia formats and are based on visual information, which would enable to teach complex knowledge and skills through visual supports. Finally, teachers argued that GBL practices could bring them closer to their students, and increase their motivation for learning. This would enable them to reach all students, including the ones that do not show interest in the learning subject, as well as hyperactive children and school leavers.

Finally, teachers regarded the game design approach as an appropriate solution to integrate GBL in their practices. Indeed, it would enable them to obtain a resources specially adapted to their teaching contexts. Furthermore, the idea of designing a game was attractive to them, and they were highly motivated in learning how to create their own ICT-based resources.

b) Perceived obstacles for becoming game designers

Teachers perceived some obstacles to the idea of designing their own LGs. First, they fear to not have the technical skills necessary to create a digital game. Furthermore, most of them did not have any experience playing games, and stated they did not know how to create a game which would be both fun and adapted to their specific teaching objectives and contexts. Indeed, teachers fear to spend time on creating a learning resource that would not be effective. They aimed to create a game that would be easily applied in the classroom. In addition, teachers saw it difficult to create games that they could re-use in different educational contexts.

Finally, teachers identified time constraints as the most important obstacle to the creation of their own LGs. Indeed, they foresaw that the game design process would involve a big amount of time. However, the high requirements implied by the curriculum do not enable teachers to develop and conduct original activities that involve time-consuming preparation.

c) Training needs

In order to address these obstacles, teachers expressed their need to receive training regarding different aspects. First, they needed technical training, in order to learn how to use the functionalities of the game editor. Second, they expressed their need for training related to GBL. Indeed, they needed to experiment different types of games as users in order to have an idea of what a game is. They also needed to learn about games' characteristics and mechanics, as well as to be acquainted with clear procedures and methods to create a game adapted to their teaching contexts.

Finally, teachers mentioned that they needed both initial and continue training, orientation and guidance, to solve problems and obstacles they might encounter all along the design process.

2.1.4. Conclusions of the exploratory study

The exploratory study enabled to confirm teachers' interest in the educational game design approach. Indeed, they highlighted their motivation for discovering new ICT-based teaching methodologies and for acquiring digital skills. Furthermore, they were willing to teach in a more natural, playful, learner-centred manner, and confirmed the potential of GBL for enhancing creative teaching practices. Indeed, GBL was described as a useful resource to bring diversity and innovation into their teaching methodologies, to get closer to their students, as well as to reach high pedagogical objectives in many curricular subjects. Furthermore, game design was perceived as an adapted solution to the integration of GBL in the classroom.

In order to overcome the obstacles inherent to the game design approach, such as their lack of technical skills and experience with games, teachers expressed their need to be acquainted with clear methods and guidelines to design their LGs. Furthermore, they needed initial training regarding technical aspects and game design, as well as continue guidance during the whole design process.

2.2. Elaboration of a model of stages for creative educational game design

In order to propose a model of stages for creative educational game design adapted to the context of my study, I considered Amabile's model of the creative process (1983, 1996), as well as different stage-based models of game design and educational game design (Crawford, 1984; Fullerton, 2008; Adams & Rollings, 2007; Morales, 2012). I adapted these models to the specific context of the research, taking into account the findings of the exploratory study, i.e. teachers' experience with ICT and GBL methodologies, and their training needs regarding educational game design. I also took into account the set of important aspects for the design and evaluation of LGs, as defined in Chapter 2.

As a result, I obtained a model of stages which can guide teachers in the design their LGs. Table 3 shows how I adapted Amabile's model of the creative process and the frameworks proposed by game studies, into a model of stages for creative educational game design.

The stages proposed are iterative, in the sense that the game ideas, mechanics, interaction system and educational contents should be tested with students since the first design stages, and adjusted accordingly. Furthermore, each stage can be experienced several times, in no definite order (e.g. teachers may have to go back to *response generation* after having tested their LGs with students and highlighted a problem). Each stage of the proposed framework is detailed in the next subsections.

STAGES OF THE CREATIVE PROCESS (AMABILE, 1983)	STAGES OF THE GAME DESIGN PROCESS (ADAMS & ROLLINGS, 2007; CRAWFORD, 1984; FULLERTON, 2008; MORALES, 2012)	STAGES OF THE CREATIVE EDUCATIONAL GAME DESIGN PROCESS (OWN ELABORATION)
Task identification	• Concept (Adams & Rollings, 2007) • Informative and analytic phase (Morales, 2012)	**Task identification** • Engagement in the task • Definition of the pedagogical objectives
Preparation (building of domain-relevant skills)	Research and preparation (Crawford, 1984)	**Preparation** • Teacher training: building of domain-relevant skills
Response generation	• Conceptualization (Fullerton, 2008) • Establishment of the design hypothesis (Morales, 2012)	**Response generation** • Conceptualization • Elaboration • Production
	Elaboration (Adams & Rollings, 2007)	
	Production (Fullerton, 2008)	
Response validation	Play-testing (Fullerton, 2008)	**Response validation** • Play-testing
Outcome (communication)	Post-mortem (Crawford, 1984)	**Outcome** • Evaluation • Communication

Table 3: Elaboration of a model of stages for creative educational game design by teachers - Own elaboration

2.2.1. Task identification

This stage corresponds to task identification in Amabile's componential model creativity (1983, 1996). From a game design perspective, it mainly relates to Morales' (2012) informative and analytic phase, which identifies the objectives of the project (i.e. pedagogical objectives, users' profile and context of use). It also contains some elements from Adams' (2010) concept stage, in which the designer defines the audience of the game.

The stage describes teachers' decision and motivation to engage in the game design task. It consists of understanding its nature, by becoming acquainted with the main functionalities of eAdventure and consulting some examples of LGs created with the editor, so to get an overview of the type of games that are possible to create. Furthermore, the stage comprises the definition of teams, i.e. teachers can decide to design their game in a collaborative or individual manner.

Finally, the stage includes the definition, by teachers, of the pedagogical objectives of their games, i.e. their targeted audience (i.e. age segment, educational level, and eventual specificities of the group of students) and the specific pedagogical objectives. Pedagogical objectives can be formal and/or transversal, and should align with the academic curriculum.

2.2.2. Preparation

This stage corresponds to preparation in the componential model of creativity, and to the research and preparation stage in Crawford's model.

It consists, for teachers, in building up different types of domain-relevant skills which are useful for undertaking the game design task. First, they need to get acquainted with game design principles, i.e. the characteristic components of games, the different genres of game, the concept of serious game, the potential of games for teaching purposes, and the important aspects to be considered for the design of LGs (as presented in Chapter 2 - Section 2.3.4). Second, teachers need to acquire technical skills related to the functionalities of the eAdventure editor.

2.2.3. Response generation

This stage corresponds to response generation in Amabile´s model, in which individuals generate candidate solutions or response possibilities. I have divided the stage in different steps, which correspond to stages from game studies' models.

a) Conceptualization

As in Fullerton's (2008) conceptualization, this step consists, for teachers, of coming up with ideas through brainstorming (i.e. generating a lot of ideas without any criticism), and tuning them into a game by defining formal elements, i.e. story, rules, goals, characters and scenes.

This step also includes the definition of additional learning activities that surround the game (e.g. briefing or debriefing discussions, lessons, exercises, etc.), in order to embed it as part of a larger learning process, within a meaningful context. Teachers also plan the strategy to evaluate the knowledge acquired through playing the game, considering that evaluation activities can take place inside or outside of the game.

Finally, teachers look at the requirements related to the application of the game in their teaching settings, such as the learning materials and the technical equipment necessary to the successful implementation of the GBL activity.

As in Morales' (2012) establishment of the design hypothesis, this step results in a design document which resumes the general concept of the game project. I called this document *GBL scenario*, and it includes different aspects, including the targeted learners (their age range, grade and special characteristics), the pedagogical objectives to be reached through the game (learning subjects, specific pedagogical objectives, transversal skills and connection to the curriculum), the description of the game formal elements (story, goal, characters, scenes), the surrounding learning activities, the evaluation approach, as well as the materials and equipment required.

b) Elaboration

This step corresponds to Adams and Rollings' (2007) elaboration stage, in which the designer moves from the general to the specific, and from the theoretical to the concrete.

It consists of designing characters, defining the game world, shaping the core mechanics, writing the story, as well as designing and integrating educational contents into the game.

This step results in a storyboard document, similar to Adams and Rollings' game script (also mentioned in Morales' model), which describes in details the following aspects:

- *Story:* game narrative, goals and outcomes;
- *Scenes:* localization, pictures, content, description of actions and dialogues, interactions with other scenes, etc.;
- *Characters:* role in the game, physical appearance, clothes, etc.;
- *Objects:* roles, description, and appearance.

c) Production

This step consists of executing the vision and plan established in the previous stages. It corresponds to the *production* phase proposed by Fullerton (2008). It includes the activities described below.

Choice or elaboration of audio-visual resources

Once the game concept and details are formalized, teachers determine the different graphical and audio resources which will give life to their game. The eAdventure software includes a library of digital objects, including graphical objects and animations (e.g. characters, objects, scene backgrounds, etc.) related to different topics (i.e. the school, the desert, the space, etc.). Nevertheless, teachers also have the possibility to design their own resources.

Programming

Programming consists of implementing the game concept with the eAdventure software, by integrating the audio-visual resources and concretizing the interaction system, i.e. setting the actions of the player, the results of these actions on the game world, the interactions between scenes, and the dialogues.

2.2.4. Response validation

In accordance with Amabile's response validation, this stage consists of testing the different elements of the LG, in order to gain insight into whether or not the game enables to achieve its objectives. It is important to involve students at different stages of the design process, so to receive on-going feedback from them and to identify problems early enough and make adjustments when necessary. This stage is mentioned in the game design models provided by Crawford, Fullerton, Adams & Rollings and Morales.

2.2.5. Outcome

According to the outcome in the componential model of creativity, and to post-mortem stage in Crawford's sequence, this last stage consists of evaluating the outcome of the design process (i.e. the LG) and communicating it to its context of use and eventually beyond.

3. Research dimensions

This section describes the dimensions to be explored in my study. As mentioned earlier, I aimed to investigate teachers' creativity in the design and application of LGs. To do so, I adopted a multidimensional approach, and explored the phenomenon of creativity through the interactions between different dimensions, i.e. process, person, press and product.

I chose to mainly concentrate on the process and product dimensions. Indeed, they are central to understand creativity during the design and application of teachers' LGs. In contrast, the person and press dimensions are regarded in terms of their influences on the different stages of the design process. Furthermore, in order to have a holistic view on teachers' experience, I examined another dimension, i.e. teaching, which concentrates on the teaching practices at stake during the application of the LGs in the classroom. To explore this dimension, I considered both teachers' and students' perspectives.

Figure 10 illustrates the three main dimensions explored through the study. In reference to the Zelda game series, it is called the Triforce[64] model. As a result of the analysis of each dimension, I aimed to define teachers' creativity in the context of the design and application of their LGs.

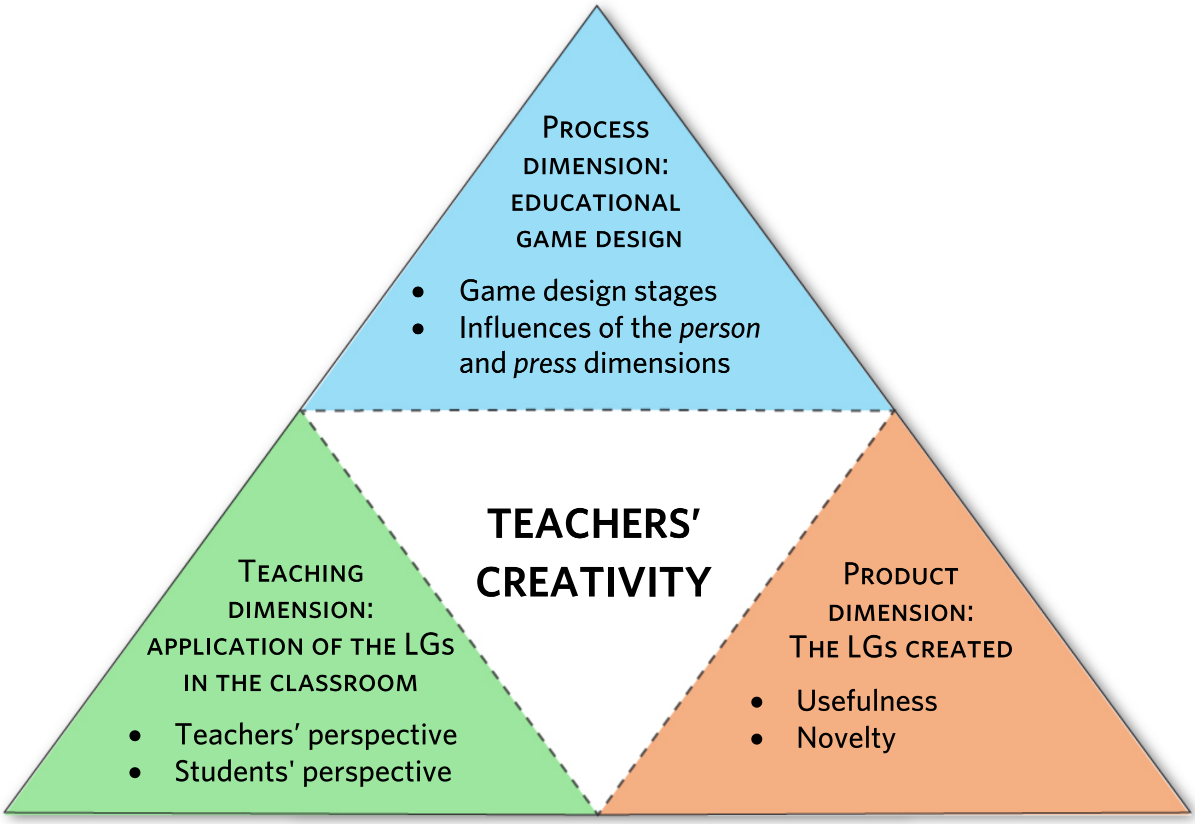

Figure 10: The "Triforce" model of teachers' creativity in the design and application of LGs

The following paragraphs describe, for each dimension, the different aspects that I examined.

[64] http://en.wikipedia.org/wiki/Triforce

3.1. Process dimension

To explore the process dimension, I looked at the different stages of educational game design, as established in section 2. Furthermore, I examined the influences of the person and press dimensions on these stages.

3.1.1. Stages of educational game design

I explored the process of educational game design according to the stages established in Section 2:

- *Task identification:* I analysed the process through which teachers engaged in the game design task and defined the pedagogical objectives of their games.
- *Preparation*: I explored teachers' experience while building different types of domain-relevant skills useful for undertaking the game design task.
- *Response generation:* I examined the different activities through which teachers conceptualized their game ideas, elaborated them, and turned them into a working game.
- *Response validation:* I looked at the play-testing activities carried out by teachers to obtain feedback on their games and operate the necessary adjustments.
- *Outcome:* I explored teachers' perceptions towards the outcome obtained, as well as the way they diffused their LGs among the educational community.

3.1.2. Influences of the person dimension: teachers' intra-individual components

As suggested in Amabile's componential model, I investigated teachers' intra-individual components that were likely to most strongly influence the educational game design process. The next paragraphs describe each of these components.

a) Domain-relevant skills

In the context of my research, this component corresponded to teachers' knowledge about the domain, i.e. the subject they aimed to teach through their LG (e.g. history, mathematics). Furthermore, my research considered a second domain of knowledge: GBL. Indeed, teachers needed to know about game design principles in order to create an entertaining product. Finally, I considered different types of technical skills, such as the ability to use the functionalities of the game editor, to edit graphics and sound elements.

b) Task motivation

I investigated the different types of motivation at stake during the game design process, i.e. intrinsic (interest in the domain, enjoyment, satisfaction, and presence of some flow elements) and/or extrinsic (external pressures of the social environment).

c) Creativity-relevant processes

I looked at teachers' personality characteristics that can promote creativity, i.e. their persistence to work, their willingness to overcome obstacles, their interest in the domain, as well as their tendency to keep options open, take risks, and tolerate ambiguity.

3.1.3. Influences of the press dimension: teachers' environment

In order to explore the external environment in which creativity happens, I looked at the specific factors which were susceptible to directly impact on the educational game design process:

- *Resources available to teachers:* I explored how the time and material resources available influenced the game design process. Furthermore, I analysed the affordances, usability aspects, and the roles of the digital environment (i.e. the eAdventure editor) on teachers' creativity.
- *The curriculum:* I analysed the way in which teachers' curricular objectives influenced the game design process.
- *Teachers' social environment:* I looked at the different actors which composed teachers' social environment, e.g. their colleagues, students and educational centre.
- *Collaborative game design processes:* some teachers engaged in the creative process in a collaborative manner. I explored the impacts of collaborative game design processes on teachers' creativity, regarding the following aspects: (a) group members, i.e. members' profiles and shared history; and (b) group processes, i.e. legislation, distribution of tasks, leadership, communication processes, relationships among group members, and indicators of group flow.

Figure 11 illustrates the way in which I studied creativity according to the process dimension.

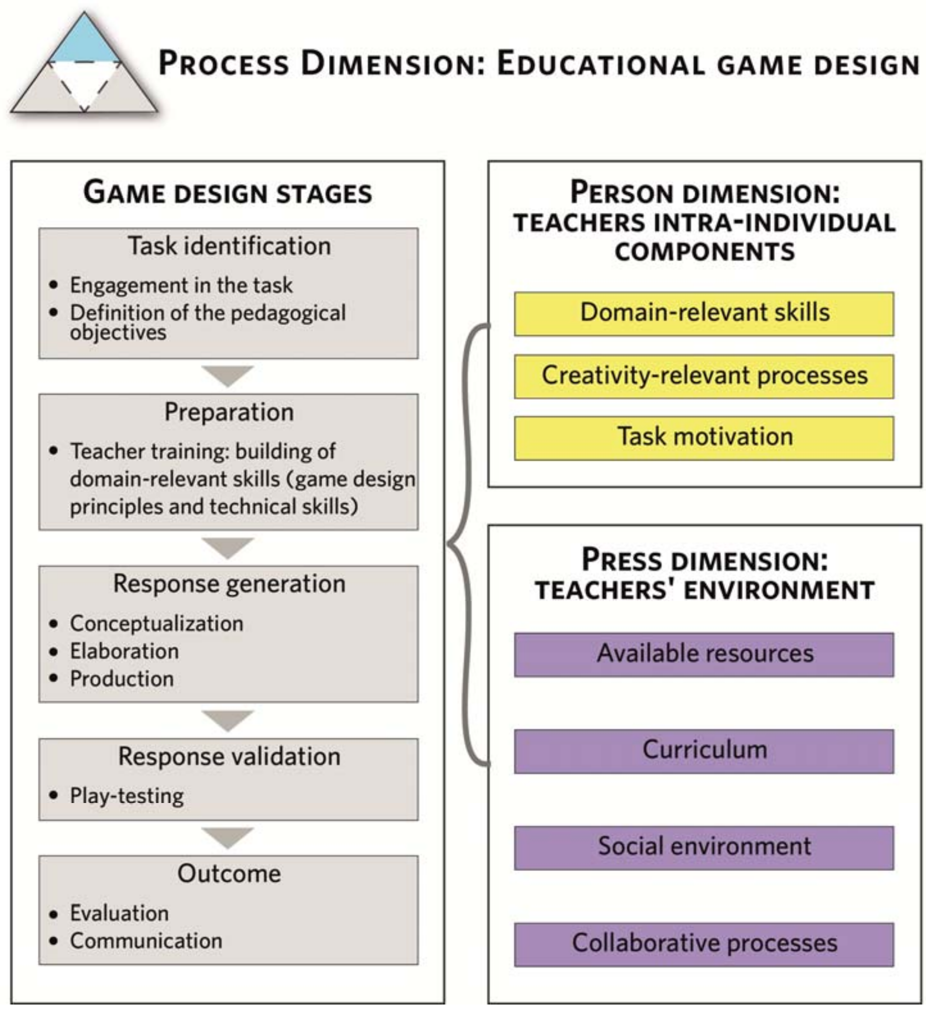

Figure 11: Study of the process dimension

3.2. Product dimension

I explored product creativity by analysing the LGs created by teachers according to two different criteria, i.e. usefulness and novelty.

3.2.1. Usefulness

In order to analyse to what extent the LGs designed by teachers were useful (i.e. adapted to their goals, that is, providing entertainment and meeting the pedagogical objectives planned), I looked at the different aspects defined as important for the design and evaluation of LGs (as established in Chapter 2):

- *Gaming aspects:* I analysed to what extent the LGs produced engaging and enjoyable experiences for players, by looking at the following aspects: (a) clarity of intermediary and final goals; (b) balance of difficulty (c) clarity and constancy of feedback; (d) clarity and consistence of rules; and (e) presence of elements which facilitate the player's immersion.
- *Pedagogical aspects:* I analysed the potential of the LGs to effectively reach the planned pedagogical objectives and achieve rich learning experiences, by examining the following aspects: (a) clarity of the pedagogical objectives; (b) alignment of game play and pedagogical

objectives; (c) appropriateness of the pedagogical objectives to the profile of the group of students; (d) planning of complementary activities which support learning with games; (e) detailed planning of students' pedagogical evaluation methodology; and (f) planning of the necessary resources to conduct the learning activity.

- *Usability aspects:* I analysed whether the functionalities of the LGs were easy to learn, interact with and navigate. To do so, I explored the following aspects: (a) easiness of use; and (b) accessibility.

3.2.2. Novelty

In order to determine the level of innovation of the LGs created by teachers, I used the following criteria:

- *Little-c creativity:* the teachers themselves.
- *Middle-c creativity:* teachers' educational communities, including their students and educational centre.
- *Big-C creativity:* the global market of educational resources and games.

Nevertheless, I chose to consider, in priority, little-c and middle-c creativity. In contrast, I gave less importance to Big-C creativity, which applies to products that are novel with respect to the whole of human history. Indeed, teachers are non-professionals in the field of game design, and would not be judged or judge themselves creative when comparing their LGs to professionally designed applications which required high costs, resources and teams of professional designers.

Figure 12 illustrates the way in which I studied creativity according to the product dimension.

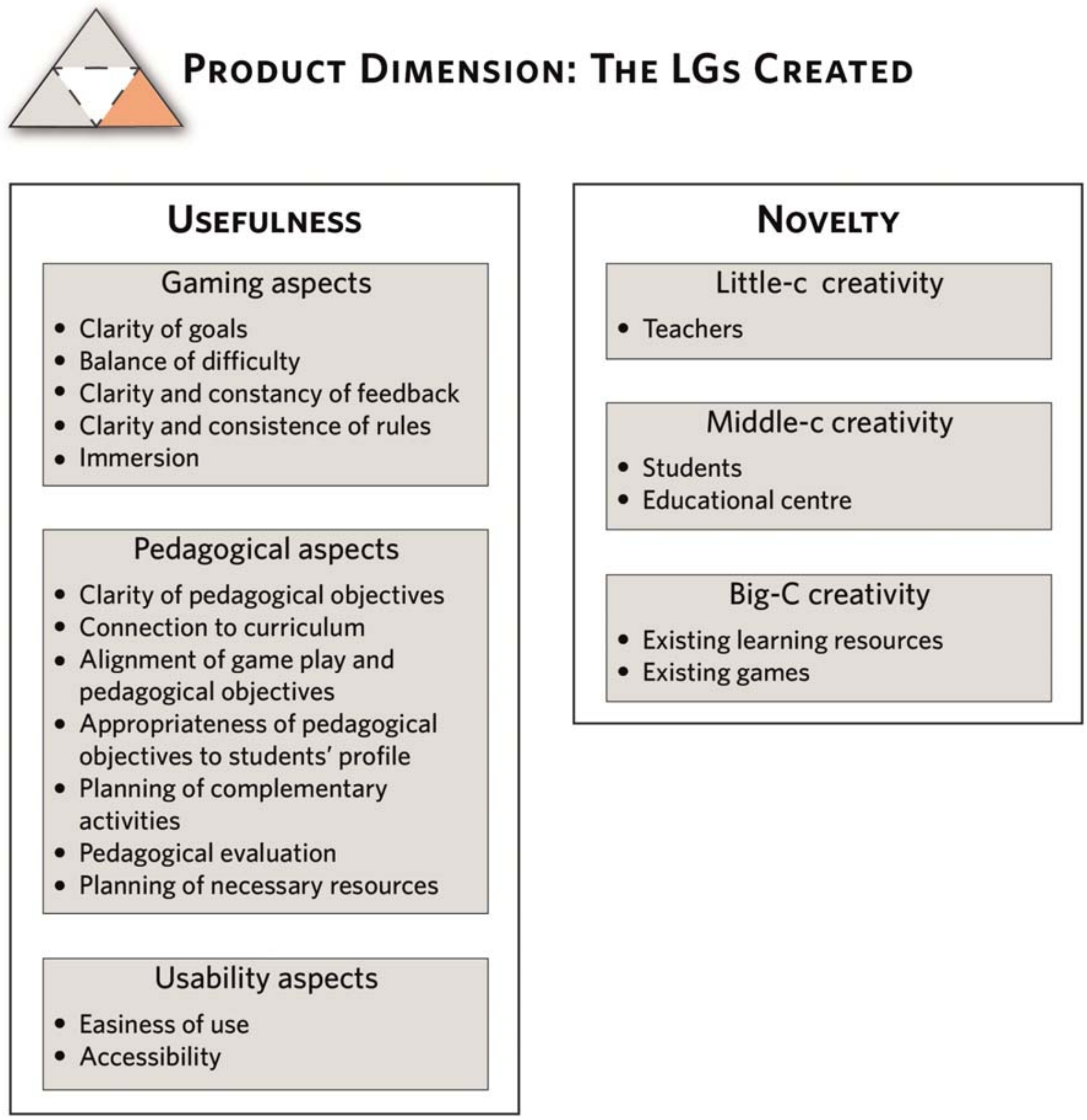

Figure 12: Study of the product dimension

3.3. Teaching dimension

I explored the teaching processes at stake during the application of the LG in the classroom. To do so, I looked at both teachers' and students' perspectives:

- *Teachers' experience:* I explored the way in which teachers organized of the GBL activity, as well as their role during the game session.
- *Students' experience:* I explored students' experience during the game session, through different indicators of the occurrence of flow, namely immersion, concentration, autonomy and social interactions. Furthermore, I explored to what extent they achieved the pedagogical objectives addressed by the LGs.

Figure 13 illustrates the manner by which I explored the teaching dimension.

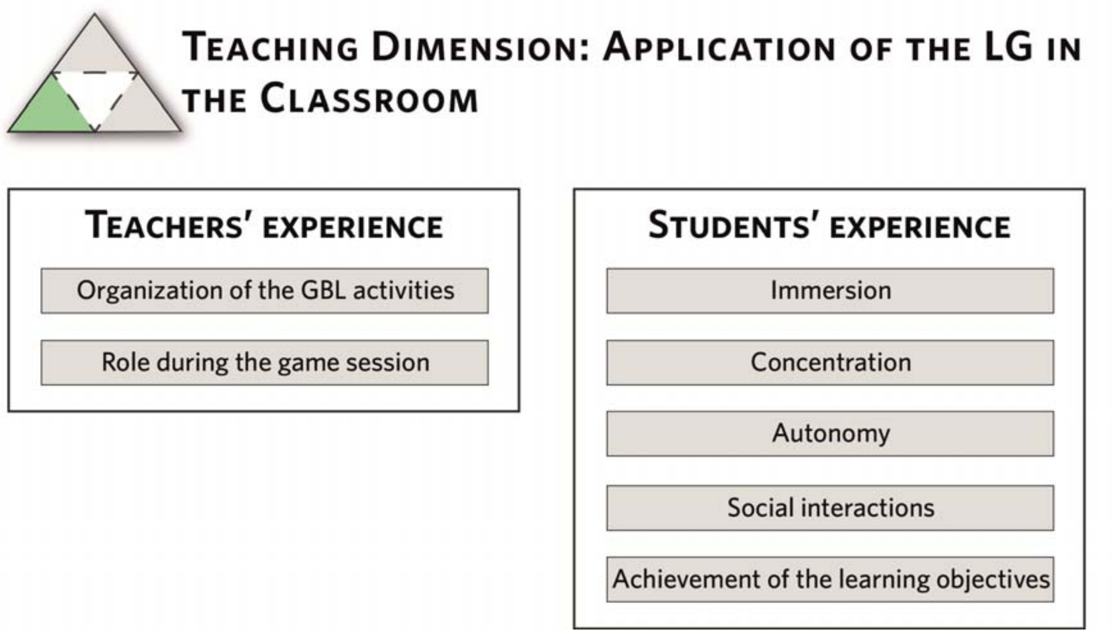

Figure 13: Study of the teaching dimension

3.4. Teachers' creativity

As a result of the analysis of the above described dimensions, I explored teachers' creativity in the context of design and application of their LGs. To do so, I examined the results with regards to the key-characteristics of creative pedagogies: (a) promoting learner-centred methodologies, (b) allowing for self-learning, (c) helping to make connections, (d) providing exploration and discovery, (e) promoting engagement, (f) providing a safe and trustful environment which encourages risk-taking behaviours, (g) adopting flexible evaluation approaches, (h) encouraging collaboration, and (i) relying on different sources, including ICT.

Summary of the chapter

This chapter presented the conceptual framework of the study. It described the theoretical choices which guided my research, and established a model for creative educational game design specially adapted to teachers. Furthermore, it outlined the different dimensions examined in order to explore teachers' creativity, i.e. process (educational game design), product (the LGs created), and teaching (the application of the LGs in the classroom). The process dimension looked at creativity at the different stages during which teachers designed their LGs. Furthermore, it analysed the influences of the person dimension (the intra-individual elements of teachers) and the press dimension (available resources and social environment) on the stages of the game design process. The product dimension examined the outcome of the design process (the LG created), according to the usefulness and novelty criteria. Finally, the teaching dimension explored the application of the LGs in the classroom, from both teachers' and students' perspectives. The next chapter concentrates on the research outline, and describes the methodological considerations, i.e. data collection and analysis strategies and tools used to evaluate these dimensions.

Chapter 4

Research outline and methodological considerations

Introduction

In the last chapter, I defined the conceptual framework of the study, i.e. the analysis of teachers' creativity during the design and application of their own LGs. This chapter aims to outline the nature of the research and the strategies used for its conduct. I used a multiple case study strategy within the methodology of qualitative educational research, in order to create a holistic picture of the complex dynamics of creativity.

The chapter reflects all the decisions made regarding the collection and analysis of data. In a first section, it states the problem, purpose and questions of the research. Second, it presents the research framework, by justifying the use of qualitative methods, specifying the paradigm and the strategy of inquiry chosen, as well as defining the unit of analysis, the sources of data and the position of the researcher. The third section describes the survey instruments used in order to explore the different dimensions of the study, while the fourth section focuses on the processes of data collection and analysis. After examining validity and reliability issues, the chapter ends with ethical considerations of relevance for the study.

1. Research outline

This section sets the direction of the study, by describing its outline and central ideas. It first presents the problem of the research, as clarified through the literature review. Afterwards, it states the overall intent of the study, and then narrows it into specific research questions.

1.1. Statement of the problem

The first task when conducting a qualitative study is "to raise a question about something that perplexes and challenges the mind" (Merriam, 2009, p. 58). The issue the researcher is curious about forms the core of the research problem. The intent of the research problem is to provide a rationale or need for studying a particular issue or problem (Creswell, 2007). As applied to the educational field, a research problem defines "a general educational issue, concern, or controversy addressed in research that narrows the topic" (Creswell, 2012, p. 60). Following these approaches, below I present the problem of my research.

My study addressed the topic of creativity in educational contexts. As observed in Chapter 2, creativity is an effective response to the transformations that feature current economies. Consequently, creativity has gained importance in the field of education, and is regarded as a skill to be developed in students. However, due to institutional pressures, teachers rarely manage to adopt creative teaching strategies. Furthermore, there is a lack of guidelines for developing pedagogical strategies which can enhance students' creativity. Hence, the need has emerged for teachers to have models and tools for including creativity in their daily practices. To tackle this need, my research focused on teachers' creative practices. It sought to provide them with new pedagogical models that can support the development of creative potential and academic learning.

Creative teaching practices can be achieved through the use of imaginative approaches. One of them is GBL. Indeed, digital games, when applied to educational contexts, can provide challenging experiences which promote students' intrinsic satisfaction, as well as offer opportunities for authentic learning and learning by doing processes. Consequently, my research regards GBL as a powerful teaching method which can promote creative teaching practices.

Literature identifies some barriers to the implementation of digital games in formal learning, such as the difficulty to reach a balance between fun and educational content, and the lack of integration of most games with curriculum requirements.

To tackle these obstacles, I chose an approach in which teachers created their own LGs, specially designed to reach their specific learning outcomes. A literature gap can be observed regarding the possibilities of game design by teachers. My research analysed teachers' creativity during the design and application of their own LGs.

PROBLEM STATEMENT

My research tackled the need for teachers to have models and tools for promoting learners' creativity and including it in their daily practices.

For the educational research community, the study aimed to provide new models for understanding how to foster creativity in educational contexts. It also explored the possibilities offered by a methodology through which teachers designed their own LGs, thus contributing to bridging the current literature gap regarding the possibilities of educational game design by teachers. In addition, it provided educational practitioners with concrete examples of creative practices, based on innovative approaches in which teachers designed their own educational resources. By examining multiple cases in various school contexts, the study enabled to better understand the place of creativity in education and in game design methodologies.

1.2. Purpose statement

In order to set the objectives and overall direction of my study, I defined the purpose statement, which provides the major intent, or the "roadmap" to the study (Creswell, 2007, p. 103). It includes different elements, i.e. the specific approach used in the study, the action of the researcher, the central phenomenon explored, the participants, and the outcomes of the research. I formulate the purpose statement of my study as follows.

Purpose statement

The purpose of my research was to analyse primary and secondary school teachers' creativity during the design and application of their own LGs. In order to analyse teachers' creativity, I looked at the game design process, the LG created as a product, and the teaching practices at stake during the application of the LGs in the classroom. My research sought to create a new model for using GBL approaches to foster creative teaching practices.

1.3. Research questions

Research questions aim to restate the purpose of the study in specific terms and to clarify what the field contacts are supposed to reveal (Flick, 2009). They guide the inquiry, by specifically explaining what the study attempts to learn or understand (Merriam, 2009). Furthermore, their formulation determines whether empirical activities will produce answers or not, as well as the decisions on the methods and processes of the study (Flick, 2009). Hence, research questions should be formulated in concrete terms. In qualitative studies, they are open-ended, evolving and non-directional. Several authors (e.g. Creswell, 2012) generally recommend having a central research question, which expresses what the researcher is first interested in understanding. The following central question directed inquiry in this multiple case study:

How can teachers' creativity be enhanced by an approach where they design and apply their own LGs?

This central question enabled to provide a rich description and analysis of teachers' creativity during the design and application of their own LGs. In addition, I posed several sub-questions (SQ), in order to narrow the focus of the study, by providing "greater specificity" (Creswell, 2012, p. 134). Hence, to answer the above mentioned central question, my study addressed the following sub-questions.

SQ1: How do teachers experience the game design process from the perspective of creativity?

This sub-question aimed to explore creativity according to the process dimension, i.e. the process of educational game design by teachers.

SQ2: To what extent are the LGs designed by teachers creative?

This second sub-question focused on product creativity, i.e. the LGs designed by teachers.

SQ3: What are the practices at stake during the application of LGs in the classroom, in relation to creativity?

This last sub-question sought to explore the teaching practices at stake during the application of the LGs in teachers' educational contexts.

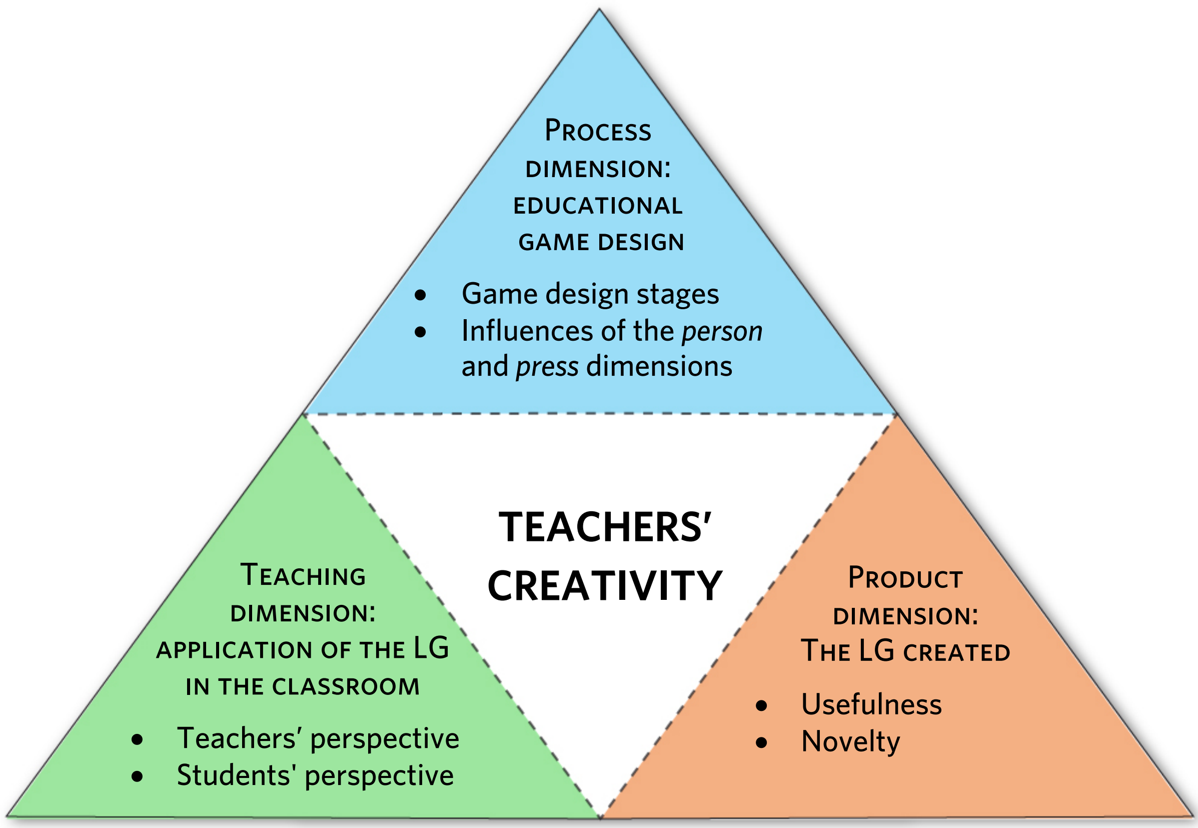

Figure 14: Conceptual framework of the study

Figure 14 illustrates the conceptual framework of the study. It highlights the different dimensions explored through the sub-questions, i.e. process, product and teaching. As shown in the figure, the process dimension studies the different stages which compose the process of educational game design. Furthermore, it explores the influences of the person and press dimensions on these stages. The product dimension, corresponding to the outcome of the design process, i.e. the LGs created, analyses two different aspects: usefulness (the extent to which the LGs achieve their objectives, i.e. by providing an entertaining experience and reaching the pedagogical objectives planned) and novelty (the level of innovation of the LGs regarding little-c, middle-c and Big-C creativity). Finally, the teaching dimension focuses on the teaching practices at stake during the application of the LGs in classroom settings, from both teachers and students' perspectives.

By analysing these dimensions, I could answer the central question of the research, represented by the central triangle in the figure, i.e. teachers' creativity.

Research questions

The following central question guided my study:

How can teachers' creativity be enhanced by an approach where they design and apply their own LGs?

In addition, the central question was answered by focusing on the following sub-questions:

SQ1: How do teachers experience the game design process from the perspective of creativity?

SQ2: To what extent are the LGs designed by teachers creative?

SQ3: What are the practices at stake during the application of LGs in the classroom, in relation to creativity?

2. Research framework

My research employed a qualitative research design, implementing a multiple case study strategy of inquiry, under a constructivist-interpretive paradigm. This section details the rationale for this decision. Afterwards, it specifies the unit of analysis, defines the different sources of data (i.e. interviews, observations, questionnaires and documents), and identifies the role of the researcher.

2.1. Rationale for qualitative research design

Qualitative research is a field of scientific inquiry in its own right (Denzin and Lincoln, 2011), which has been increasingly used from the mid-twentieth century, in a variety of fields such as education, health, and social work (Merriam, 2009). Indeed, qualitative methods can adapt to several disciplines, fields and subjects, and have a special relevance in contemporary research (Flick, 2009). Denzin and Lincoln (2011) define qualitative research as "a situated activity that locates the observer in the world", and consists of "a set of interpretive practices that make the world visible" (p. 3).

While quantitative methods concentrate on determining cause and effect, predicting and describing the distribution of some attributes among a population, qualitative methods seek to "uncover the meaning of a phenomenon", by focusing on "how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences" (Merriam, 2009, p. 5).

Qualitative researchers intend to understand social or human problems (Creswell, 1998, 2007). Furthermore, they are interested in making sense of people meaning and subjective experiences (Flick, 2009; Merriam, 2009). As stated by Merriam (2009), "the overall purposes of qualitative research are to achieve an understanding of how people make sense of their experience, delineate the process (rather than the outcome or product) of meaning-making, and describe how people interpret what they experience" (p. 14).

To reach these purposes, qualitative researchers develop an intimate relationship with the object of their study (Denzin and Lincoln, 2011). They seek to make sense of the phenomenon from the participants' perspectives, by collaborating with them through an "insider" perspective (Merriam, 2009, p. 14). Hence, qualitative research is conducted in natural settings (Creswell, 1998, 2007; Denzin and Lincoln, 2011).

Qualitative approaches aim to build a complex and holistic picture of the phenomenon at hand (Creswell 1998). To do so, they recognize a variety of perspectives on the object. Hence, they use diverse approaches and methods, such as case study, interview, artifacts, observations, as well as a wide range of interconnected interpretive practices (Denzin & Lincoln, 2011).

Qualitative research is also characterized by the role of the researcher as the primary instrument of data collection and analysis (Merriam, 2009). Indeed, researchers' reflections form part of the knowledge production, and their subjectivity becomes part of the research process (Flick, 2009).

Consequently, the product of the qualitative research process consists of a rich description of the phenomenon (Merriam, 2009), based on research participants' perspectives and on the researcher's interpretation.

Rationale for selecting a qualitative design

My research aimed to understand teachers' creativity during the design and application of their LGs. In order to provide a rich description of creativity complex dynamics, I needed to address participants' points of view, and to closely examine their activities in a naturalistic setting. Hence, I selected a qualitative approach. It enabled to get an intimate picture of teachers' specific experience, to approach their subjective perspectives, as well as to collect extensive data on the many variables that composed the experience, by examining their natural milieu over an extended period of time. Qualitative methods allowed for a rich understanding of the phenomenon, based on varied perspectives, and enabled to gain insights on creativity which would not have been possible using other types of research.

2.2. Selection of the research paradigm: a constructivist-interpretive approach

All research approaches have an underlying paradigm which implicitly guides every aspect of the study. A paradigm can be defined as a "basic set of beliefs that guide action" (Guba, 1990, as cited in Denzin and Lincoln, 2011, p. 91). It shapes the worldview of the researcher (Creswell, 2007), determines what questions they ask, and how these questions are answered (Denzin and Lincoln, 2011).

A paradigm consists of three different dimensions (Lincoln, Lynham and Guba, 2011): (a) *ontology* refers to the nature of the reality to be studied; (b) *epistemology* specifies the nature of the relationship between the researcher and what can be known; and (c) *methodology* refers to the practical way in which the researcher proceeds in order to discover the reality. As resumed by Denzin and Lincoln (2011), the researcher "approaches the world with a set of ideas, a framework (theory, ontology) that specifies a set of questions (epistemology) that he/she examines in specific ways (methodology, analysis)" (p. 11).

Many eminent authors highlight similar paradigms. Denzin and Lincoln (2011) define four major paradigms in qualitative research, namely positivist- post-positivist, constructivist-interpretive, critical and feminist-post-structural. In contrast, Creswell (2007) presents four worldviews that inform qualitative research, i.e. post-positivism, social constructivism, advocacy-participatory and pragmatism. In the following paragraphs, I describe the dominant paradigms in educational research, namely positivism, post-positivism, constructivism (also known as interpretive), and critical theory, in the light of Guba and Lincoln (1994).

- *Positivism:* for this paradigm, ontology is characterized by naive realism, as an apprehendable reality is assumed to exist, driven by immutable natural laws. Hence, findings are considered to be true. Epistemology is dualist and objectivist, as the investigator and the investigated objects are independent. Hence, the researcher can study the object without influencing it or being influenced by it. Methodology is experimental and manipulative, as questions and hypotheses are stated in a propositional form, and subjected to empirical test. Quantitative techniques are predominant within this perspective.
- *Post-positivism:* ontology is labelled as critical realism, as reality is assumed to exist, but is imperfectly apprehendable. Hence, findings are considered to be probably true. Regarding epistemology, dualism is abandoned, while objectivity remains as an ideal. Methodology uses inquiry in more natural settings, collecting more situational information, thus increasingly using qualitative techniques.
- *Critical theory:* regarding ontology, reality has been shaped over time by different factors (e.g. social, political, cultural) and is now immutable. Epistemology is transactional and subjectivist, as the investigator is linked to the investigated object. Findings are value-mediated, as the values of the researcher influence the inquiry. Methodology is dialogic and dialectical, as inquiry requires a dialog between the researcher and the subjects.
- *Constructivism:* ontology is relativist, as there are multiple, socially constructed realities. Epistemology is subjectivist, as the investigator and the investigated are linked and co-create understandings. Methodology is qualitative, naturalistic, and recognizes a subjective relationship between the researcher and the subject.

Table 4 summarises the epistemological, ontological and methodological assumptions underpinning these paradigms.

	Positivism	**Post-positivism**	**Critical theory**	**Constructivist-interpretive**
Ontology	Naive realism: reality is "real" and apprendible	Critical realism: reality is "real", but imperfectly apprehendible	Historical realism : reality was shaped by social, political and cultural values, and crystallized over time	Relativism: there are multiple realities which are socially constructed
Epistemology	• Dualism and objectivism • Findings are true	• Modified dualism and objectivism • Findings are probably true	• Subjectivism • Findings are co-created	• Critical subjectivism • Findings are co-created
Methodology	• Experimental and manipulative • Verification of hypotheses • Mainly quantitative methods	• Modified experimental and manipulative • May include qualitative methods	• Dialogic and dialectical	• Naturalistic • Qualitative methods

Table 4: Comparison among the dominant paradigms in educational research (adapted from Denzin, Lynham and Guba, 2011)

Rationale for selecting the constructivist-interpretive paradigm

My research attempted to make sense of teachers' creativity within the design and application of their LGs. It aimed to construct knowledge on the complex phenomenon of creativity on the basis of teachers' subjective perceptions, interpretations, meanings and experiences in a particular social context. Hence, I aimed to explore creativity as a socially constructed reality, through interactions with people, discovering how they made sense of their experience in natural settings, through meaning-oriented methodologies. Consequently, the interpretive approach seemed to be the most pertinent for the objectives of this study.

2.3. Selection of the strategy of inquiry: a multiple case study

Case studies are a common way to conduct qualitative inquiry (Stake, 2005). They have been used in many disciplines such as psychology, sociology, and political sciences (Yin, 2009). Furthermore, they have been increasingly used in educational research. Indeed, as stressed by Merriam (1998):

> Educational processes, problems and programs can be examined to bring about understandings that in turn can affect and perhaps improve practice. Case study has proven particularly useful for studying educational innovations, for evaluating programs, and for informing policy (p. 41).

2.3.1. Definition and characteristics

Creswell (2007) defines case study research as follows:

> A qualitative approach in which the investigator explores a bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information (e.g. observations, interviews, and documents), and reports a case description and case-based themes (p. 73).

The scope of case studies may be a programme, an event, an activity or a set of individuals bounded in time and place (Merriam, 1998). Hence, a case is a bounded system (Stake, 2005). It has working parts, purposes and is set within its real-world context (Yin, 2009).

Case researchers explore the entity or phenomenon during a sustained period of time (Merriam, 1998). They collect detailed information by using multiple sources of data found in the settings. For example, Yin (2003) recommends using six different sources of evidence, i.e. documents, archival records, interviews, direct observations, participant observation and physical artifacts. Hence, case studies gain credibility by triangulating descriptions and interpretations continuously over the period of the study (Stake, 2005).

As mentioned by Stake (2005), case researchers look at both what is common and particular about the case. To the author, a case is a complex entity located in a milieu and embedded in a number of contexts that are important to take into account, including historical, cultural, physical, social, economic, political, and ethical. Hence, researchers gather data on the nature of the case (i.e. its activity and functioning), but also consider the influences of its different contexts. Finally, they study the informants through whom the case can be known.

Case researchers are reflective, in the sense that they are “committed to pondering the impressions, deliberating on recollections and records”. They “dig into meanings, working to relate them to contexts and experience” (Stake, 2005, p. 450). In the author’s words, “qualitative case study is characterised by researchers spending extended time on site, personally in contact with activities and operations of the case, reflecting, and revising descriptions and meanings of what is going on” (p. 450).

2.3.2. Advantages and limitations

Literature recognizes many advantages of case studies. First, case study research enables to conduct an in-depth exploration of a phenomenon, so that the researcher can “retain the holistic and meaningful characteristics of real-life events” (Yin, 2009, p. 4). It brings researchers towards “understandings of what is important about that case within its own world” (Stake, 2005, p. 450), so they can provide “an intensive, holistic descriptive analysis” (Merriam, 2009, p. 40). The insights provided by case studies can be used as tentative hypotheses for future research. Hence, case study “plays an important role in advancing a field’s knowledge base” (p. 51).

The limitations of case studies mainly relate to scientific generalization (Merriam, 2009; Yin, 2009). Indeed the question of generalization of results from a single case often arises. Yin (2009) answers this question by stating that, like experiments, "case studies are generalizable to theoretical propositions and not to populations or universes". Furthermore, Merriam (2009) argues that much can be learnt with a single case through the researcher's narrative description, and that what is learnt from a case can be applied to others.

2.3.3. Rationale for using case study methods in the present research

To Merriam (2009), case studies are suitable when the researcher seeks for a rich, thick description and analysis of a phenomenon. To Creswell (2007), they are relevant when the researcher aims to provide an in-depth understanding of the cases, or a comparison of several cases. Furthermore, Yin (2003) argues that the need for case studies arises when one wants to understand complex social phenomena. The author argues that this method is preferred when the research poses "how" and "why" questions about a contemporary set of events (2009, p. 13). Several authors (e.g. Merriam, 1998, 2009; Yin, 2009) agree that the strengths of case studies make them particularly appealing for educational research.

2.3.4. Different types of case studies

There exist different types of case studies. Stake (2005) distinguishes between intrinsic (when the study is undertaken, first and last, in order to reach better understanding of this particular case), instrumental (when the case is examined mainly to provide insight into an issue or to draw a generalization) and multiple case studies (when a number of cases is studied together in order to investigate a phenomenon, population, or general condition.).

According to Yin (2009), relying on a single-case design may leave the researcher vulnerable by having all the eggs in one basket (p. 61). Multiple data sources enhance data credibility. Furthermore, multiple case studies bring more success than single-case designs in terms of analytic benefits, as emerging conclusions from two cases "will be more powerful than those coming from a single case alone" (p. 61). Hence, findings are reinforced from multiple cases, by "filling a gap left by the first case or respond better to some obvious shortcoming or criticism of the first case" (p. 62).

Rationale for selecting a multiple case-study strategy

Case study strategy created a suitable strategy for my research. Indeed, it enabled to develop an in-depth understanding of the creativity phenomenon, by exploring the design and application of LGs by primary and secondary school teachers. Through different sources of evidence, I had the opportunity to closely approach teachers involved in this experience in their natural settings, and to apprehend their different contexts. Furthermore, I reflected on the meaning, and provided a holistic descriptive picture of the whole experience. Hence, case study methods allowed for the deep analysis of the themes related to creativity complex dynamics.

Yin's arguments towards the use of a multiple case study design guided my choice of approaching various groups of teachers, so to collect data from different perspectives and experiences, and to obtain stronger and more compelling findings. As a result, I chose to study the creativity phenomenon by approaching different groups of teachers issued from different schools.

2.4. Unit of analysis

The unit of analysis is "related to the fundamental problem of defining what the case is" (Yin, 2009, p. 29). As mentioned by Creswell (2012), "in qualitative inquiry, the intent is not to generalize to a population, but to develop an in-depth exploration of a central phenomenon" (p. 206). Furthermore, Patton (2002) notes that "qualitative inquiry typically focuses in-depth on relatively small samples, even single cases, selected purposefully" (p. 230). Hence, the qualitative researcher usually concentrates on a few individuals or cases, in order to provide an in-depth picture of the explored phenomenon.

The term used for qualitative sampling is "purposeful sampling". Indeed, researchers intentionally "select people or sites that can best help understand the central phenomenon" (Creswell, 2012, p. 206). These "information rich cases" bring on issues of central importance to the purpose of the research (Patton, 2002, p. 230).

In addition, Creswell (2012) identifies several sampling strategies that educators frequently use, among others: *maximal variation sampling*, in which the researcher samples cases or individuals that differ on some characteristic (e.g. different age groups); *extreme case sampling*, in which the case studied displays extreme characteristics; *typical sampling*, in which the researcher studies a person or site that is typical to people who are unfamiliar with the situation; *homogeneous sampling*, in which individuals or sites are sampled based on membership in a subgroup that has defining characteristics; and *critical sampling*, in which individuals or sites are studied because they represent the central phenomenon in dramatic terms.

Unit of analysis

The unit of analysis of my study was composed of **three groups of teachers from two different Spanish educational centres (primary and secondary schools), who collaboratively designed their LGs, and one teacher from a different school, who designed his LG in an individual manner**. Each group of teachers represents a single case or unit of analysis.

A purposeful sampling process characterized the choice of participants. I used the following sampling strategies:

• *Critical sampling:* the main criterion was teachers' interest towards introducing innovative GBL methodologies in their educational contexts;

• *Achievement of the game design process:* for some teachers, the game design process took longer that they initially thought. Due to their professional activities, they could not finalize their games. The study concentrated on those teachers who achieved their LGs.

• *Maximal variation sampling:* in order to allow for comparison, criteria also included teachers' affiliation to different centres, and the modality adopted to design their LGs (i.e. collaborative or individual).

2.5. Sources of data

According to Yin (2009), findings are likely to be more convincing and accurate if the research is based on several different sources of information. Furthermore, Patton (2002) argues that multiple sources of data can "provide cross-data validity checks" (p. 248). Indeed, "no single method can grasp all the subtle variations in on-going human experiences" (Denzin & Lincoln 2011, p. 12). Hence, qualitative researchers usually employ a wide range of methods, including different perspectives, in order to provide a holistic picture of the phenomenon studied.

Sources of data used for my research

In order to approach the phenomenon of creativity from different perspectives and to ensure the credibility of the research, I gathered data from different sources, i.e. interviews, observations, questionnaires and documents.

The following paragraphs describe the different methods used in my study.

a) Interviews

Interviews are essential sources of case study information (Yin, 2009). According to Creswell (2012), they occur "when researchers ask one or more participants general, open-ended questions and record their answers. The researcher then transcribes and types the data into a computer file for analysis" (p. 217).

In qualitative research, interviews consist of "guided conversations" (Yin, 2003, p. 89). They use open-ended questions, which allow for in-depth responses from participants, who can "best voice their experiences" (Creswell, 2012, p. 218). Hence, interviews enable to capture participants' experience as expressed in their own words (Creswell, 2007). The researcher asks about "the facts of a matter as well as their opinion about events" (Yin, 2003, p. 90).

Creswell (2012) identifies a number of approaches to interviewing, such as one-to-one interviews (the researcher asks questions to only one participant at a time) and focus groups (used to collect shared understanding from several individuals). As stated by the author, "focus groups are advantageous when the interaction among interviewees will likely yield the best information and when interviewees are similar to and cooperative with each other" (p. 218).

The use of interviews in my study

The predominant form of data source consisted of interviews with the participants of the research. By posing open-ended questions, interviews provided the flexibility required for understanding the phenomenon studied, i.e. creativity. Furthermore, they provided participants with the opportunity to speak freely, to reflect and to voice their opinion about their experience while designing and applying their LGs. Interviews were conducted in person.

I used both focus groups and one-to-one interviews, focus groups being preferred when exploring the collaborative processes at stake during the game design process. I maintained a neutral and empathic position, by listening to the interviewees' experiences with openness and respect without judgment.

b) Observations

Observations are a well-accepted form of qualitative data collection. They define "the process of gathering open-ended, first-hand information by observing people and places at a research site" (Creswell, 2012, p. 213). To the author, observations provide the opportunity to "record information as it occurs in a setting, to study actual behaviour, and to study individuals who have difficulty verbalizing their ideas (e.g. preschool children)" (p. 213-214). Furthermore, observations enable to "capture the context", with the intention of building a better understanding of the phenomenon from a "holistic perspective" (Patton, 2002, p. 262).

Using observation requires adopting a particular role as an observer. As mentioned by Creswell (2012), different roles exist, such as participant observer (i.e. when the researcher takes part in activities in the setting observed) and non-participant observer (when the researcher records notes without becoming involved in the activities).

The use of observations in my study

In the context of the research, I used observations in order to study teaching and learning processes at stake during the application of LGs in the classroom. I adopted a non-participant role, in order to gain insight on the natural processes at hand in the classroom within the game session, such as teachers' interactions with students, teachers' overall approach to teaching, and students' interactions with the games and among them.

c) Questionnaires

My research is situated in the qualitative framework. However, it contains some aspects of descriptive quantitative data. As mentioned by Creswell (2012), quantitative methods are useful for collecting data from a large number of people and comparing groups. Quantitative instruments (e.g. survey questionnaires, standardized tests, and checklists) include specific questions and response possibilities established in advance. Data is collected in the form of numbers. The author identifies different ways of collecting quantitative data, including attitudinal measures, which enable to measure feelings towards an educational topic.

The use of questionnaires in my study

I have used two questionnaires in the context of the research:

(a) a nominal scale, aiming to explore some specific aspects of creativity regarding the game design process, as well as to collect participants' comments on these aspects.

(b) an interval scale, aiming to obtain data on students' experience of enjoyment while playing. It enabled to get data from a wide range of young students (63).

Questionnaires were used with the aim to triangulate data obtained through qualitative methods.

d) Documents

Documents represent a growing data source for qualitative researchers. As described by Creswell (2012), they consist of "public and private records that qualitative researchers obtain about a site or participants in a study" (p. 223). This type of information can take many forms (Yin, 2003): they can be either public (minutes from meetings, official memos, archival material in libraries) or private (personal journals and diaries, letters, personal notes, and e-mails). As a main advantage, documents are in the language and words of the participants, who have usually given thoughtful attention to them (Creswell, 2012). However, documents are mainly used to corroborate and to augment evidence from other sources (Yin, 2003).

The use of documents in my study

In the context of the research, I gathered documentation from different sources (e-mail communication with teachers, storyboards, articles and posters prepared by teachers), in order to corroborate the information from interviews and observations, regarding the creative processes at stake during the game design process.

2.6. Role of the researcher

As mentioned earlier, qualitative research focuses on the socially constructed nature of reality. In this context, researchers develop an "intimate relationship" with what is studied (Denzin and Lincoln, 2011, p. 8). Hence, they become "the primary instrument for data collection and analysis" (Merriam, 2009, p. 15). To Denzin and Lincoln (2011), the researcher can use multiple and gendered images, such as bricoleur, scientist, naturalist, film-maker, and journalist. In contrast with quantitative methods, in which data collection procedures are routinized, qualitative methods require an experienced researcher, because of the continuous interaction between the theoretical issues and the data (Yin, 2003). The author identifies some required skills to conduct case study research, including the ability to ask good questions and to be a good listener, as well as adaptability and flexibility.

My role in the research

Besides of collecting and analysing data, I have been in close collaboration with teachers for more than two years: first, when I introduced them to the research approach during the exploratory focus groups; then, during training sessions, in which I taught them how to create their own LGs; afterwards, during the game design process, I have been in close contact with them for three months, either by mail, by phone, or face-to-face, in order to provide them support whenever needed; furthermore, I went to the sites (i.e. the schools) in various occasions: to help them designing their games, and for the application of the LGs in the classrooms.

All along this process, I became an insider within the group of teachers, and could develop a trustful relationship with them. I attempted to be sensitive and respectful, asking good questions, and listening without judgment.

3. Data collection strategies

This section describes the different survey instruments used in the study, i.e. questionnaires, interviews, observations and documents. First, it presents the main survey instruments, each of them allowing for the exploration of a different dimension, i.e. process, product or teaching. Second, it presents the instruments which were designed and used in order to triangulate evidence from the data collected through the main instruments.

3.1. Main data collection instruments

Instrument 1: teachers' interviews (process dimension)

The first type of interviews aimed to explore creativity according to the process dimension, i.e. teachers' experiences during the game design process. The interview protocol was built on the basis of an open-ended questionnaire (Instrument 4, which is later presented in section 3.2), which was used at the end of the game design process, in the context of a preliminary survey. The interview aimed to deepen the topics highlighted by the results of the questionnaires. It consisted of a series of open-ended questions which address the following aspects:

- *The stages which compose the educational game design process*: (a) task identification; (b) preparation; (c) response generation; (d) response validation; and (e) outcome.
- *The influences of intra-individual components on the game design process:* domain-relevant skills, creativity-relevant processes and task motivation.
- *The influences of the environmental components on the game design process*: available resources (i.e. time, material resources and digital environment), teachers' social environment, and collaborative game design processes.

Furthermore, I prepared probes (i.e. sub-questions asked to elicit more information) in order to eventually clarify some points and have interviewees expand on some ideas.

I prepared two different interviews protocols, i.e. the first one to conduct focus groups with the teams of teachers who deigned their LGs in a collaborative manner (a part of the interview focuses on collaborative creativity at stake during the design process), and the second one to conduct an individual interview with the teacher who designed his LG by himself. Both interview protocols are available is Annex 7.1.

Instrument 2: experts' interviews (product dimension)

A second type of interviews, involving experts in GBL, looked at product creativity, i.e. the LGs designed by teachers. Interviews examined two different criteria, i.e. usefulness (the degree to which the LGs achieved their goals, i.e. providing entertainment and meeting the pedagogical objectives planned by teachers) and novelty (their level of innovation regarding little-c, middle-c and Big-C creativity).

As mentioned in Chapter 2, a previous study (Annex 1.1) performed in ProActive (in which I participated) enabled to identify and formulate a set of important aspects to be considered for the design and evaluation of LGs (See Chapter 2, Section 2.3.4, p. 63). On this basis, I created a questionnaire to evaluate the LGs produced by teachers. The questionnaire consisted of a scale, listing different items corresponding to the different aspects listed in Chapter 2. The questionnaire followed a validation process with different experts in the field of GBL:

- *Christelle Mariais (University of Grenoble, France):* PhD on learning role-playing games, and consultant in innovative training solutions.
- *Davinia Hernàndez-Leo (University Pompeu Fabra, Spain):* Professor at the Information and Communications Technologies Department, coordinator of the Educational Technologies research line of the Interactive Technologies Group (GTI), Vice-Principal of the Pompeu Fabra Polytechnic School and Director of its Unit for Teaching Quality and Innovation.
- *Nicola Whitton (Manchester Metropolitan University, United Kingdom):* Research Fellow at the Education and Social Research Institute, co-director of the Centre for Research in Technology, Innovation and Play for Learning, and co-chair of the Association for Learning Technology Games and Learning Special Interest Group.
- *Thomas Duus Henriksen (Aalborg University, Denmark):* Associate Professor and specialist in LGs for adults;
- *Joeren Bourgonjon (Ghent University, Belgium):* PhD, Research Fellow at the Department of Educational Studies, specialized in GBL;

Validations forms are available in Annexes 6.1 to 6.5.

The validation process revealed that the instrument needed to be tested through a preliminary survey. Hence, it was field tested with other experts in GBL, who evaluated some of the LGs created by teachers:

- *Marcelino Cabrera (University of Granada):* teacher and researcher specialized in the use of digital games in educational settings, member of the research group Digital Games and E-Learning (Laboratorio de Investigación en Videojuegos y E-Learning).
- *José Luis González (University of Lleida):* teacher and researcher specialized in the creation and analysis of digital games.
- *Maria Victoria Martín (University of Barcelona):* PhD in educational technologies.

This second validation process revealed that an interview would be more adapted than a questionnaire, in order to collect qualitative data on the respondents' experience while playing the games. Consequently, I designed an interview protocol on the basis of the validated set of criteria. Furthermore, I tested this protocol during two classroom sessions: the first one with design students from the Faculty of Arts (University of Barcelona) who created and evaluated their own LGs (a picture from the session is available in Figure 15), and the second one with pedagogy students (University of Barcelona, Faculty of Pedagogy) from the 4th course in the subject *Entorns, processos I recursos tecnològics d'aprenentatge* (technological learning environments, processes and resources) who evaluated some of the LGs created by teachers. Finally, the set of criteria passed a last validation process with an expert in GBL, Joan Morales (design researcher and teacher at the Faculty of Arts, PhD on GBL at the University of Barcelona).

Figure 15: Picture from the validation of the protocol with students from the Faculty of Arts (31-05-2012)

Figure 16 resumes the process of design and validation of the interview protocol.

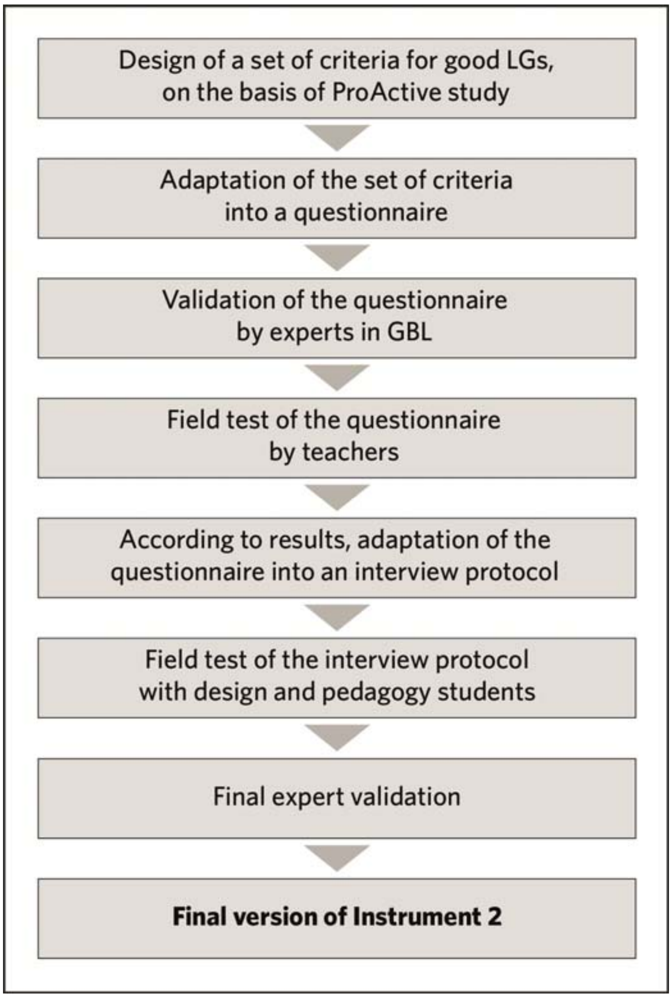

Figure 16: Process of design and validation of Instrument 2

As a result, the protocol consists of 21 items which address the usefulness and novelty criteria by examining the following aspects:

- *Gaming aspects:* the five items from this category analyse to what extent the LGs provide engaging and enjoyable experiences;
- *Pedagogical aspects:* this category includes nine items which explore whether the LGs enable to reach the pedagogical objectives planned by teachers and achieve rich learning experiences;
- *Usability aspects:* the five usability items analyse whether the LGs are easy to learn, interact with and navigate.
- *Innovation aspects:* furthermore, two items explore the level of innovation of the LGs regarding Big-C creativity.

The interview protocol is available in Annex 7.2. Table 5 describes the different criteria used in the interview protocol to evaluate the different aspects of product creativity.

Themes explored		**Items**
Usefulness, i.e. relevance of the LGs to specific teaching contexts	**Gaming aspects**	1. Clarity of intermediary and final goals 2. Balance of difficulty 3. Clarity and constancy of feedback 4. Clarity and consistence of rules 5. Presence of elements which facilitate the player's immersion
	Pedagogical aspects	6. Clarity of the pedagogical objectives 7. Connection to the curriculum and associated competences 8. Alignment of game play and pedagogical objectives 9. Appropriateness of the pedagogical objectives to the profile of the group of students 10. Planning of complementary activities which support learning with games 11. Detailed planning of students' pedagogical evaluation methodology 12. Adequate use of documentation resources 13. Planning of the necessary resources to conduct the learning activity 14. Attention to diversity
	Usability aspects	15. Easiness of use 16. Minimization of errors and dead points 17. Easiness of installation 18. Compatibility 19. Accessibility
Innovation aspects	**Big-C**	20. Existing learning resources 21. Existing games

Table 5: Topics addressed in Instrument 4, and related items

As shown in Table 5, the items of the final version of the instrument are different in comparison with the original set of aspects defined in Chapter 2. Indeed, as a result of the validation process, some items have been added:

- *Adequate use of documentation resources:* the access to learning documents and materials, as well as complementary information sources, such as external links and bibliography.
- *Attention to diversity:* the consideration of students' specific socio-cultural and psycho-pedagogical characteristics.
- *Minimization of mistakes and dead points:* minimizing mistakes in the software, and game states in which there is no possibility of further progress.
- *Easiness of installation:* easy, fast and transparent installation of the game material.
- *Compatibility:* game performance on most common platforms in schools.

Instrument 3: teachers' interviews (product and teaching dimensions)

Finally, a third type of interview aimed to explore teachers' perspectives towards the product and teaching dimensions. It looked at the following topics:

- *Usefulness and novelty of the LG created:* first, interviews aimed to explore teachers' perspectives regarding the product dimension. The same interview protocol was used than for Instrument 2. Nevertheless, three items were added in order to explore their perceptions of innovation regarding little-c (the originality of the LGs in comparison with their usual teaching practices and resources) and middle-c (the originality of the LGs regarding students and the educational centres) creativity.
- *Teaching processes at stake during the application of the LGs in the classroom:* second, interviews aimed to explore teachers' perspectives on the teaching dimension, by looking at the organization of the GBL activities (i.e. the implementation of activities to support learning and the pedagogical evaluation strategies), their role during the GBL session (i.e. their interactions with students and the classroom environment), and students' experience (i.e. their engagement during the game session, and the achievement of the pedagogical objectives).
- *Teachers' general perception the research approach:* finally, the interview aimed to collect teachers' general perspectives on the approach implemented in this research (i.e. the design and application of their own LGs), i.e. the related opportunities, obstacles and solutions, as well as their perspectives on teachers' creativity.

The interview protocol was validated within the GREAV research group[65], as well as with other researchers who participated in the ProActive project. The protocol is available in Annex 7.3.

3.2. Complementary instruments used for triangulation purposes

Instrument 4: teachers' questionnaire (process dimension)

This open-ended questionnaire aimed to explore teachers' creativity within the educational game design process. Questions aimed to collect teachers' perspectives regarding the different stages of the

[65] http://greav.ub.edu

creative process. The instrument was exploratory. Indeed, it was used within a preliminary survey (described in Chapter 5), with the objective to identify topics of interest and elaborate a relevant interview protocol (Instrument 1). Furthermore, the results of the questionnaires were used to corroborate information obtained through Instrument 1.

The questionnaire was designed on the basis of the stages of educational game design identified in Chapter 3. In order to ensure content validity, it was submitted to a validation process. It was reviewed by an expert panel composed of five researchers and professionals in the fields of creativity and GBL:

- *Martin Owen (Futurelab, United Kingdom):* he is a specialist in the use of digital games, mobile technologies, innovation, social software, and innovation in education. He was director of Learning, Development and Head of Concept Development at Futurelab. During this period, he was responsible for and inventor of a number of SGs and mobile learning applications.
- *Anuska Ferrari (European Commission, Belgium):* she is a researcher and policy analyst in the area of ICT for learning. She recently worked on research projects related to creativity and innovation in education. She was a scientific officer for the European Commission (Joint Research Centre, Institute for Prospective Technological Studies).
- *Avril Loveless (University of Brighton, United Kingdom):* she is a professor at the University of Brighton. Her research and teaching tackle understandings of creativity, pedagogy, and ICT.
- *Begoña Gros (University of Barcelona, Spain):* she is a PhD in education and teaches at the University of Barcelona. In recent years, she has been Head of Research in the Division of Education Sciences, and Head of Research at the Institute of Education Sciences of the University of Barcelona. She is specialized in the use of digital games in educational contexts.
- *David Cropley (University of South Australia):* Associate Professor of Engineering Innovation, and Deputy Director of the Defence and Systems Institute. His interests include creativity in an engineering and technological context, the measurement of creativity, the factors that influence creativity and innovation in organisations.

The validations form is available in Annex 6.6. Experts evaluated whether the items were valid in relation to the concepts of the study. This process helped in rewriting all items that were not clear, eliminate imprecise elements, and consider new suggestions to be added when useful.

As a result, the questionnaire consists of a nominal scale through which participants check one or more categories that describe their position towards the topic at stake. It presents 20 items corresponding to different characteristics of the stages of educational game design. For each item, there are two options which describe opposite characteristics. Respondents were asked to choose between the different options and to provide a short comment to explain their choice. It was also possible to select the two options. Hence, the questionnaire does not consist of a dichotomic instrument, as the two options aim to orient respondents towards a choice, but are not exclusive. The questionnaire addresses the following topics:

- *Task identification:* the questionnaire includes one item related to teachers' motivation (intrinsic or/and intrinsic) to engage in the game design task.
- *Preparation:* this topic includes two items related to the acquisition of domain-relevant skills.
- *Response generation:* the questionnaire comprises 12 items related to the conceptualization, elaboration and production steps. It also contains items related to collaborative processes and the flow experience.
- *Response validation:* this topic includes three items related to the validation activities carried out by teachers to obtain feedback on their games and operate the necessary adjustments.
- *Outcome*: this topic contains two items related to teachers' satisfaction regarding the design process, and the evaluation of their LGs.

The instrument is available in Annex 7.4.

Instrument 5: students' questionnaire (product and teaching dimensions)

A questionnaire was given to students who played the LGs created by their teachers, in order to explore their gaming experience. The next paragraphs describe the process of elaboration of this questionnaire.

Sweetser and Wyeth (2005) have created GameFlow, a model of evaluation of games based on the concept of flow, as defined by Csikszentmihalyi (see Chapter 2). It aims to analyse players' level of enjoyment in a game. The model consists of an evaluation checklist which includes different factors in games that can enhance the occurrence of flow experience (e.g. immersion, clarity of goal, autonomy, feedback, concentration and challenge). As stated by Fu, Su and Yu (2009), GameFlow is considered a relevant tool for evaluating games. Indeed, the model was presented at the ACE'07 International Conference and is recognized by many authors in game studies.

With the aim to evaluate LGs, Fu, Su and Yu (2009) reformatted GameFlow into a questionnaire. Furthermore, they added the factor of knowledge improvement, in order to take the learning dimension into account. The result is a scale called EGameFlow, which was validated through five different tests (content validity, construction validity, criterion-related validity, convergent validity, and divergent validity). This scale was well adapted to measure the adequacy of the games created by teachers to their students' profile. Indeed, it enables to analyse whether the LGs are entertaining, and allow for the achievement of the pedagogical objectives planned by teachers. Furthermore, the flow elements match many of the criteria used in this study to evaluate LGs.

In order to adapt the questionnaire to the context of the study, I had to simplify it, i.e. I reduced the number of questions, and adapted the language so questions could be understood by children. Furthermore, I added two items in order to explore students' perspectives regarding the innovation aspect. These minor changes from the initial instrument were validated within the GREAV quality research group, by a speech therapist specialized for young children (Laura Ventura Reixac), and my director, Dr. Mario Barajas.

Table 6 outlines the process of adaptation of the different factors of flow proposed by Csikszentmihalyi, towards the final version of the questionnaire.

Csikszentmihalyi flow elements (1991)	Sweetser and Wyeth gameflow model (2005)	Fu, Su and Yu eGameflow model (2009)	Students' questionnaire (own elaboration)
Concentration	Concentration	Concentration	Concentration
Challenge	Challenge	Challenge	Challenge
	Player Skills	Knowledge improvement	Knowledge improvement
Control	Control	Autonomy	Autonomy
Clear goals	Clear Goals	Clear goals	Clear goals
Feedback	Feedback	Feedback	Feedback
Merging of action and awareness	Immersion	Immersion	Immersion
Loss of self-consciousness			
Transformation of time			
Autotelic experience			
n/a	Social Interaction	Social Interaction	Social Interaction
n/a	n/a	n/a	Innovation

Table 6: Adaptation of the factors from the flow elements to the questionnaire

As a result, the questionnaire consists of 28 items, as shown in Table 7 (also see Annex 7.5).

Factors	Items
Challenge	1. The game was challenging, but I felt capable of solving it 2. The game was neither too difficult nor too easy 3. The game provided support that help me overcome the challenges
Goal clarity	4. I clearly understood the instructions of the game 5. While I was playing, I knew exactly what I had to do and to reach
Feedback	6. The game was informing me on my progress 7. Each time I gave an order to the game, it did it 8. The game was informing me on my success or failure
Autonomy	9. It was easy for me to manage the game 10. It was easy to learn how to use the game
Concentration	11. I was totally concentrated while I was playing 12. It was easy to not be distracted while I was playing
Immersion	13. I felt involved with the game 14. I enjoyed playing and I would like to play more 15. I didn't care about wining, as I was having a great time by only playing 16. I forgot about my surroundings while playing the game 17. I forgot about my worries while playing the game 18. Time passed very quickly while playing the game
Social interactions	19. I was talking to my classmates while playing 20. I solved some of the game tasks with the teacher 21. I solved some of the game tasks with my classmates
Knowledge improvement	22. The game motivated me to learn 23. I understood what the game wanted to teach me 24. I applied knowledge learnt in the classroom while playing the game 25. I learnt new things with the game 26. I want to know more about the topic taught in the game
Innovation	27. This way of learning is new for me 28. In the school, we are not used to this type of activities

Table 7: Adapted scale of EGameFlow

In the context of my study, the questionnaire was used to gain insight regarding both the product and the teaching dimensions. As shown in Table 8, the items from the factors challenge, goal clarity, feedback, autonomy, immersion, and innovation were used to analyse some themes of the product dimension. The items from the factors concentration, immersion, social interactions and knowledge improvement enabled to explore some themes from the teaching dimension.

Factors	Items	Themes of product dimension	Themes of teaching dimension
Challenge	1. The game was challenging, but I felt capable of solving it	Balance of difficulty	
	2. The game was neither too difficult nor too easy		
	3. The game provided support that help me overcome the challenges		
Goal clarity	4. I clearly understood the instructions of the game	Clarity of goals	
	5. While I was playing, I knew exactly what I had to do and to reach		
Feedback	6. The game was informing me on my progress	Clarity and constancy of feedback	
	7. Each time I gave an order to the game, it did it		
	8. The game was informing me on my success or failure		
Autonomy	9. It was easy for me to manage the game	Easiness of use	Autonomy
	10. It was easy to learn how to use the game		
Concentration	11. I was totally concentrated while I was playing		Concentration
	12. It was easy to not be distracted while I was playing		
Immersion	13. I felt involved with the game	Immersion	Immersion
	14. I enjoyed playing and I would like to play more		
	15. I didn't care about wining, as I was having a great time by only playing		
	16. I forgot about my surroundings while playing the game		
	17. I forgot about my worries while playing the game		
	18. Time passed very quickly while playing the game		
Social interactions	19. I was talking to my classmates while playing		Social interactions
	20. I solved some of the game tasks with the teacher		
	21. I solved some of the game tasks with my classmates		
Knowledge improvement	22. The game motivated me to learn		Achievement of the pedagogical objectives
	23. I understood what the game wanted to teach me		
	24. I applied knowledge learnt in the classroom while playing the game		
	25. I learnt new things with the game		
	26. I want to know more about the topic taught in the game		
Innovation	27. This way of learning is new for me	Novelty	
	28. In the school, we are not used to this type of activities		

Table 8: Distribution of the items of the questionnaire in the themes from the product and teaching dimensions

Instrument 6: classroom observation (teaching dimension)

Classroom observations were used in order to explore the teaching and learning practices at stake during the application of the LGs in the classroom. According to a broad-to-narrow perspective, a first observation round was organized in June, 2011, during a preliminary survey, in two sites: one primary and one secondary school located in Galicia. During two classroom sessions, four games were tested, involving five teachers and 46 students. It consisted of a broad observation, and enabled to explore the general landscape. According to the results of the survey, I designed an observation protocol in order to narrow the aspects to be explored during the main data collection process.

The obtained protocol enabled to plan the recording of descriptive (description of events, activities and people) and reflective (personal thoughts, insights and broad ideas) field notes, in structured way. It addressed the following aspects:

- Teaching practices, i.e. organization of the game session and role in the classroom (interactions with students, monitoring of learning, management of difficulties, negotiations, adjustments);
- Indicators of flow experience indicators, i.e. concentration, immersion, autonomy, and social interactions.
- Classroom environment, i.e. free and relaxed environment, trusting relationships among students and teacher.
- Technical aspects, i.e. interaction with computers, the software and the game.

The observation protocol is available in Annex 7.6.

Instrument 7: game design documentation

In order to corroborate and increase evidence from the questionnaires and the interviews, I collected documentation related to the game design process. I looked at the following documents:

- *E-mail communication with teachers during the game design process:* it provided useful information on the nature of the support asked by teachers, their motivation, their level of skills, the difficulties they met, as well as the evolution of their LGs.
- *Storyboards from the games:* storyboards were created at the beginning of the design process, in order to plan the game world and core mechanics. They created a valuable source of information to compare what was planned initially by teachers, and the final product obtained.
- *Articles and posters published by teachers about their LGs:* in the context of the ProActive final conference[66], teachers wrote articles on their experience while designing and applying their LGs. These articles reflect teachers' language and words, and enabled to directly access their perspectives.

[66] GACET' 2011 – Games and Creativity in Education and Training - www.ub.edu/euelearning/proactive/conference/index.html

Documents are available in Annexes 8.1.7, 8.2.7, 8.3.7 and 8.4.5.

Table 9 details all the instruments used for exploring the different dimensions of the research and answering their related sub-questions.

	MAIN SURVEY INSTRUMENTS			TRIANGULATION INSTRUMENTS			
	1. Teachers' interview	2. Experts' interview	3. Teachers' interview	4. Teachers' questionnaire	5. Students' questionnaire	6. Classroom Observation	7. Game design documentation
Process dimension	X			X			X
Product dimension		X	X		X		
Teaching dimension			X		X	X	

Table 9: Correspondence of data collection instruments with research dimensions

4. Validity and reliability

Within the processes of data collection and analysis, it is necessary to ensure the accuracy of findings and interpretations (Creswell, 2012). Indeed, qualitative research is characterized by the centrality of the role of the researcher and is, in consequence, highly interpretive. Hence, in order to ensure the validity of the study, researchers need to be self-reflective about their interpretations of findings, as well as the personal and political history that shape these interpretations. As stated by Patton (2002), "qualitative inquiry, because the human being is the instrument of data collection, requires that the investigator carefully reflect on, deal with, and report potential sources of biases and error" (p. 51).

There exist many perspectives on the definition and procedures of validation in qualitative research (Creswell, 2007). For example, Lincoln and Guba (1985) proposed alternative terms to the positivist terminology: "terms such as credibility, transferability, dependability and confirmability replace the usual positivist criteria of internal and external validity, reliability and objectivity" (Denzin & Lincoln, 2011, p. 13). These dimensions have subsequently been accepted as trustworthiness criteria for qualitative research. The next paragraphs describe the strategies used in the research in order to meet them.

4.1. Credibility

Credibility defines the confidence in the truth of the findings. To achieve this criterion, I have used different strategies proposed by Lincoln and Guba (1985):

- *Prolonged engagement:* it consists of investing sufficient time in the field to build trust with participants, learn the culture, and check for misinformation. For more than two years, I observed teachers during each stage of the game design process. I provided them with training and then supported them in the design and application of their LGs. Consequently, I could build trustful relationships with teachers and got the opportunity to immerse into their culture and daily activities.
- *Triangulation:* it defines the use of multiple sources, methods, investigators, and theories to corroborate evidence. I used different types of data which was collected with different

methods (interviews, observations, questionnaires and document analysis) and from different individuals (teachers, students, and experts in GBL).

- *Peer debriefing:* this process provides an external check of the research process. Two of my colleagues, both with expertise in GBL and qualitative research, were asked to review and comment on the study, data analysis, and findings. One of them, Dr. Anna Trifonova, is a doctor in Informatics, and was actively involved in the ProActive project. She furnished her viewpoints on the research approach, data collection strategies and findings. The second colleague, Silvia Alcaraz-Domínguez, imparted valuable insights during the collection and analysis of data. Indeed, she was actively involved in the research during the training and design stages. Their participation contributed to the credibility of the findings.
- *Member checking:* this practice consists of asking participants of the research to check the accuracy and interpretation of findings. The draft study was reviewed by one of the teachers from the cases.

4.2. Transferability

Transferability consists of showing that the findings can be applied in other contexts. This criterion can be achieved through *thick description*, i.e. describing the phenomenon in sufficient detail so the reader can evaluate the extent to which the conclusions are transferable to other times, settings, situations, and people (Lincoln & Guba, 1985).

The present research studied various cases characterized by a contextual diversity, which strengthened its ability to generalize findings. However, in order to enable the reader to make judgments of transferability, I provided a rich, thick description of the cases, by carefully describing settings and participants.

4.3. Dependability

Dependability aims to show that the findings are consistent and could be repeated. To Lincoln and Guba (1985), this criterion can be met through external audits, involving an external researcher examining both the process and product of the account, and assessing their accuracy.

In the present study, this criteria was met through the continuous audit of several researchers, i.e. Dr. Joan Morales, Dr. Anna Trifonova, Silvia Alcaraz-Domínguez (as presented above), and my tutor, Dr. Mario Barajas.

4.4. Confirmability

Confirmability consists of demonstrating that findings stem from the respondents and the context, and not researcher bias, motivation, or interest. Lincoln and Guba (2005) propose different methods to ensure confirmability, including the following:

- *Audit trail:* it defines a transparent description of the steps taken from the start of the research to the reporting of findings. It includes raw data (e.g. recorded materials and written field notes), data reduction and analysis products (e.g. field notes and condensed notes), data reconstruction and synthesis products (the structure of categories, findings, conclusions, and a final report), process notes (including methodological notes, trustworthiness notes and audit trail notes), materials relating to intentions and dispositions (e.g. inquiry proposal, personal notes and expectations) and instrument development information (e.g. pilot forms, preliminary schedules, and observation formats). I built a repository including traces from the different research activities (agendas and participation lists from the exploratory focus groups and training workshops), the data collected (transcriptions from interviews, observation field notes, documentation, including e-mail communication, storyboards documents and articles), and validation procedures.

- *Triangulation:* As explained above, I used different types of data which was collected with different methods and from different individuals.

Strategies used to meet validity and reliability in my study

To guarantee the accuracy of findings, I made sure to meet the following criteria:

• *Credibility:* it was ensured by prolonged engagement, triangulation, peer debriefing and member checking;

• *Transferability:* it was ensured by the elaboration of a rich, thick description;

• *Dependability:* it was ensured by the continuous audit of several external researchers;

• *Confirmability:* it was ensured by the elaboration of an audit trail, and triangulation of data.

5. Ethical considerations

As mentioned by Creswell (2012), all educational researchers need to be aware of and anticipate ethical issues in their research. The author outlines some ethical concerns that should be taken into account during data collection. These include the respect of the site in which the research takes place, i.e. researchers should gain permission to enter a site, and disturb it as little as possible. Regarding data reporting, it is necessary to show respect to readers, by reporting data honestly without altering findings, giving credit to material quoted, and communicating in an understandable, jargon free manner.

In addition, Merriam (2009) mentions the protection of subjects from harm, the right to privacy, the notion of informed consent, and the issue of deception. To the author, the nature of ethical dilemma depends on the researcher's sensitivity and values, more than on a set of pre-established guidelines.

Patton (2002) offered a checklist of general ethical issues to consider. Among them, I highlight the following: explaining purpose (clarify to participants the purpose of the evaluation and methods), reciprocity (advantages for people to participate in the study), assessment of risk (eventual risks involved by their participation in the study), confidentiality (what are reasonable promises of confidentiality that can be fully honoured?), and data access and ownership (who has access to the data?).

Ethical research protocols considered during my study

During the whole process of my research, I considered participants' perspectives at all time. First, I informed them, in an accurate and understandable manner, of the purpose and methods of the study. Regarding reciprocity, I made sure that teachers would find advantages in participating in the study: they were provided with training and support to create their own educational resources, and learnt about an innovative teaching methodology. In addition, I made sure that teachers' and students' participation in the study would not involve risks of any kind. I maintained the confidentiality of teachers' opinions, by protecting identities with pseudonyms, assigned and known only by me. Regarding data collection, I made sure to disturb as little as possible when on the sites. Also, all participants agreed to the taping of interviews for research purposes, and were made fully aware that the transcript would become part of the research data set. All participants gave their agreement for the use of data. Verbal permission from participants was obtained before all audio interviews.

6. Data analysis strategies

Data analysis aims to make sense of the information supplied by individuals in the study to form answers to research questions (Creswell, 2012). To the author, analysing data consists of "taking the data apart" to determine individual responses and then "putting it together" to summarize it (p. 10). The author identifies various steps for organizing data, which are described in the following sections.

6.1. Preparation and organization of data for analysis

The first step defines the preparation and organization of data for analysis. It includes different strategies for qualitative and quantitative methods.

Regarding qualitative data, it consists of organizing the vast amount of information, transferring it from spoken or written words to a typed file. This can be done either through hand analysis (i.e. by reading the data, marking it by hand, and dividing it into parts), or using qualitative computer programs. Hand analysis is preferred when analysing small data bases, easily keeping track and locating text passages, and when time allows for the "labor-intensive activity to manually sort, organize, and locate words in a text database" (Creswell, 2012, p. 240). On the other hand, using computer programs facilitates the process of storing, analysing, sorting, and visualizing large databases.

As for questionnaires, preparing and organizing data consists of scoring it (i.e. assigning a numeric value to each response category for each question on the instruments), determining the types of scores to use, and clearing the data.

I followed Creswell's steps for qualitative data analysis to prepare data from interviews and observations. Furthermore, for students' questionnaire, I followed the author's steps for quantitative analysis. Related procedures are detailed in Chapter 5.

6.2. Exploring and coding data

The second step consists of exploring and coding data. Coding is the "process of segmenting and labelling text to form descriptions and broad themes in the data" (Creswell, 2012, p. 243). Themes (or categories) define "similar codes aggregated together to form a major idea in the database" (Creswell, 2012, p. 245). The author distinguished between different types of themes, i.e. major and minor themes (that represent the major and the minor secondary ideas in a database).

According to the conceptual framework and the research questions (as defined in Chapter 3), I established a system for coding data: I organized the different themes of my research dimensions into different segments of information, and labelled these segments in codes. I organized themes into different layers, from basic elementary themes to more sophisticated ones. Furthermore, I interconnected them to highlight the relations between the different themes.

Summary of the chapter

This chapter clarified the methodological process of my research. It presented all the strategies used in the study for collecting and analysing data. It outlined the problem and the purpose of the study, as well as defined the research central and sub-questions. It also defined the strategy of inquiry (i.e. a qualitative research design, implementing a multiple case study strategy of inquiry, under a constructivist-interpretive paradigm), and the unit of analysis (three groups of teachers, from two different schools, and one teacher from another school). The chapter also detailed the different survey instruments used in the research, i.e. questionnaires, interviews, observations and documents. Finally, it defined the criteria used to guarantee the validity and reliability of findings, the protocols considered to ensure the respect of ethical issues, and set the strategies for data analysis.

The next chapter describes the implementation of this methodological process, i.e. its concrete application on the field. It presents the different stages of the research, including the application of the research approach to foster teachers' creativity, the preliminary survey conducted in order to refine the data collection tools, the selection of cases, as well as the procedures followed to perform data collection and analysis.

Chapter 5
Implementation

Introduction

The last chapter clarified the methodological process of the study, by defining the statement of the problem, formulating the research questions, selecting the strategy of inquiry, unit of analysis, and sources of data. In this chapter, I focus on the research scenario, i.e. the staging of the fieldwork. I have divided this multidimensional process into five broad stages, i.e. application of the stages for educational game design (applied in the context of training workshops and design activities), preliminary survey (conducted during a first round of application of LGs with students), selection of cases (it describes the different units of analysis of the study, i.e. the groups of teachers who designed and applied their LGs), data collection (the main data collection process conducted during a second round of application of LGs with students) and data analysis. The chapter is organized according to the structure outlined in Figure 17.

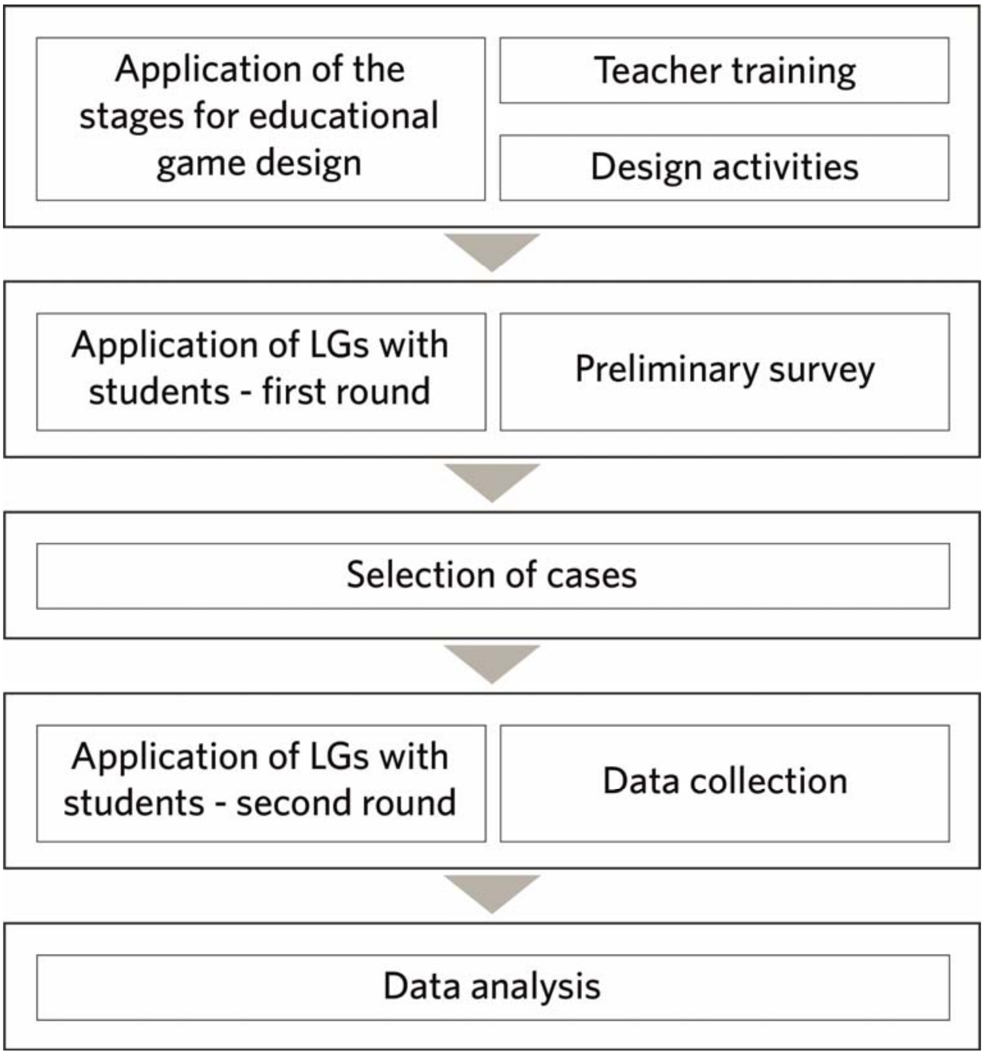

Figure 17: Stages of the implementation of the research approach

1. APPLICATION OF THE STAGES FOR EDUCATIONAL GAME DESIGN

In Chapter 3, I have defined a model of stages for creative educational game design, as shown in Table 10. This section describes the way these stages were concretely applied with teachers, during training workshops and design activities.

STAGES FOR EDUCATIONAL GAME DESIGN BY TEACHERS (OWN ELABORATION)
Task identification - analysis
Preparation - building of domain-relevant skills
Response generation - conceptualization, elaboration and production
Response validation - play-testing
Outcome - communication and evaluation

Table 10: Stages for educational game design by teachers (own elaboration)

1.1. Teacher training

In February, 2011, I organized training workshops with educators from different primary and secondary schools, in order to teach them how to design their own LGs. These workshops were conducted in the context of the ProActive project. The main objectives were to present the research project to the participants, to teach them the main concepts around GBL, as well as to acquaint them with the functionalities of the eAdventure editor. The first part of the section explains how the training workshops were organized in terms of participants and settings. The second part focuses on the structure and the content of the workshops.

In total, 21 teachers from seven primary and secondary schools attended the training workshops. From those, six had attended the exploratory focus groups carried out in May, 2010. Nine of them were informed about the study by their colleagues who had attended the focus groups. Finally, the six other participants had heard about the research project activities through different dissemination channels. Most of participants were teachers from primary or secondary schools. Furthermore, there were two educators at the university level and one participant from a company. The participation lists are available in Annex 3.2.

The training workshops were organized in February, 2011, in the Faculty of Pedagogy of the University of Barcelona, in the premises of the Campus Mundet, and lasted for 12 hours. The participants could choose between two modalities, i.e. an intensive modality, which consisted of two sessions distributed in two days, and an extensive modality, which consisted of four sessions of three hours distributed in four weeks. The agendas of the two training modalities are available in Annex 3.3. All sessions took place in computer rooms equipped with at least one computer per participant. There was also an internet connection and a projector. Figure 18 shows pictures from the training workshops.

Figure 18: Pictures form the training workshops.

Besides of face-to-face workshops, online support was given to teachers through a Moodle platform, which was accessible through the Virtual Campus of the University of Barcelona. Participants could access the materials from the course (slides from the workshops, eAdventure software and user guide) and forums to exchange ideas and ask for support.

1.1.1. Task identification stage

All teachers who participated in the training workshops had made the decision to engage in the task, i.e. the design and application of their LGs. The first session of the training activities aimed to provide them with the necessary information to understand the nature of the task. Activities consisted in introducing them to the concepts of games and GBL, and in presenting them the main affordances of the eAdventure game editor. To do so, teachers were invited to play different LGs created with the editor, so to have an idea of the type of games that they would be able to create.

Afterwards, teachers established their teams, i.e. they decided whether they would design their game in a collaborative or individual manner. On this basis, the members of the different teams defined the pedagogical objectives of their LGs, i.e. the targeted audience (i.e. the age segment, educational level, and eventual specificities of the group of students), the learning subject, the specific objectives and the transversal skills addressed by the game.

1.1.2. Preparation stage

The second part of the training aimed to prepare teachers for the game design task, by providing them with the necessary information and skills. Activities consisted in teaching them the main concepts around GBL, including the characteristics that define games, the different genres of game, the concept of SG, the potential of games for teaching purposes, and the important aspects to be considered for the design of LGs (as presented in Chapter 2 - Section 2.3.4). Furthermore, during hands-on sessions, teachers learnt how to use the functionalities of the eAdventure editor.

1.1.3. Response generation stage

Once acquainted with the main concepts around GBL and eAdventure, teachers started to design their LGs. Response generation activities (i.e. conceptualization, elaboration and production) started during the training workshops, and continued afterwards.

Conceptualization

Through a brainstorming session, teachers generated the first ideas of their LGs. They were told to write down a lot of ideas, in a free manner and without any criticism.

Afterwards, teachers refined these ideas by elaborating a design document called GBL scenario, in which they defined the formal elements of their game, i.e. plot, goals, characters and scenes. They also designed additional learning activities that would surround the game (e.g. briefing or debriefing discussions, lessons, outdoors activities, exercises, etc.), in order to embed the use of the game within a complete learning process. Teachers also imagined the strategy to evaluate the knowledge acquired by students through playing the game. Finally, they examined the requirements involved by the application of the game in the classroom, such as the learning materials and the technical equipment necessary to the success of the activity. The GBL scenario template is available in Annex 3.4.

At the end of the training workshops, teachers had the core idea of their LGs. They were prepared for the next steps of the game design process, i.e. elaboration and production.

1.2. Design activities

After the training workshops, an on-going collaboration process took place during three months (from March to May, 2011), in which I provided support to the participating teachers while they were designing their games. Support was given through face-to-face meetings and online (through the Moodle course and through e-mails), and was mainly related to game design strategies (writing of game storyboards) and technical guidance (help on the usage of the game editors). This section describes the design activities undertaken by teachers after the training workshops.

1.2.1. Response generation stage (continuation)

The response generation stage, which started during the training workshops, continued afterwards, as teachers elaborated their ideas in a storyboard document and produced their games.

Elaboration

Teachers were provided with examples of storyboards of games designed with eAdventure. On this basis, they elaborated their storyboard documents, including more or less detailed descriptions of the game story, scenes, characters, objects and game mechanics.

Production

Once the game was ready on paper, teachers concentrated on planning and elaborating the audio-visual resources which would give life to their game. Afterwards, they implemented the elements of their games with the editor, by integrating the audio-visual resources and programming the interaction system.

1.2.2. Response validation stage

Teachers tested their game all along the design process, in order to gain insight and receive on-going feedback on the game dynamics and contents, and proceed to the necessary adjustments. They used different strategies, such as self-testing and play-testing sessions with students.

1.2.3. Outcome stage

At the end of the game design process, teachers used their LGs with their students in real teaching settings. Some of them observed students' interactions with the game and proceeded to some improvements accordingly. Furthermore, some teachers diffused their LGs among the educational community, and, in some cases, continued their projects in other contexts. GBL sessions are described further in this chapter.

2. Preliminary survey

At the end of the design process, during a first round of application of LGs with students, I organized a preliminary survey in order to refine concepts, research questions, and test data collection strategies with target users. This section describes the organization and results of this survey.

2.1. Organization of the survey

The preliminary survey consisted of the following strategies:

- *Process dimension:* I used the teachers' questionnaire (Instrument 4). It was filled-in by 14 teachers who designed their LGs.
- *Product dimension:* in order to assess the appropriateness of the LGs, I used a questionnaire based on the set of important aspects to be considered for the design and evaluation of LGs, elaborated in the context of ProActive. It was given to independent experts in the field of GBL, each of them evaluating a different LG. Furthermore, in order to evaluate the novelty criteria, teachers were asked whether they perceived their LGs innovative regarding different criteria.
- *Teaching dimension:* I conducted in-depth interviews with two teachers who applied their LGs with their students. In addition, I performed observations (see Figure 19) in order to examine

teachers' and students' behaviours during the game sessions: four games were tested during two classroom sessions (one in a primary and another in a secondary school). 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; three other teachers did so with a group of 21 students from first year of post-compulsory secondary school, age 16. Figure 19 shows pictures from the classroom observation.

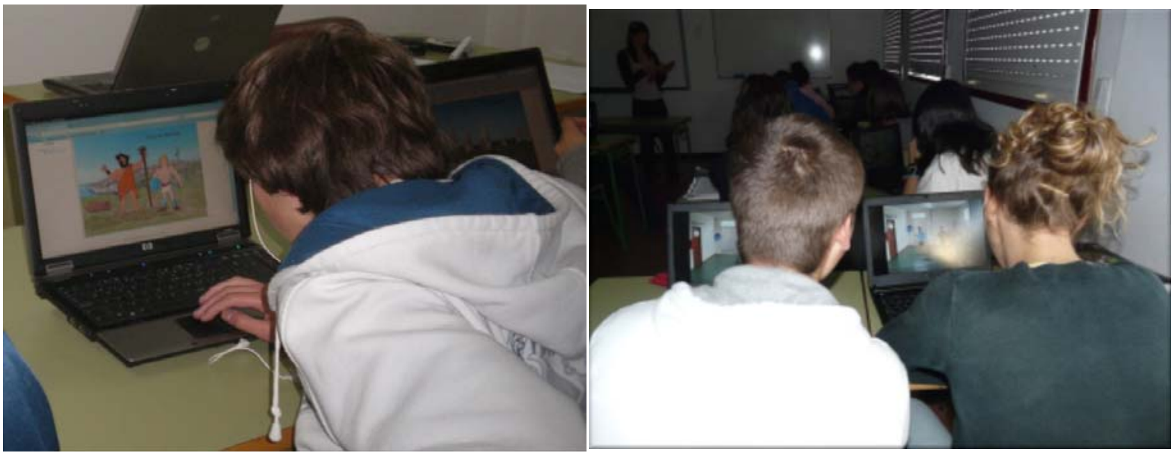

Figure 19: Pictures from the classroom observation

The dimensions, instruments and people involved in the preliminary survey are resumed in Table 11.

Research dimensions	Instruments	Participants
SQ1: Process dimension	Teachers' questionnaire	14 teachers
SQ2: Product dimension	Expert questionnaire	3 experts
SQ3: Teaching dimension	Classroom observation	4 teachers and 46 students
SQ3: Teaching dimension	Teachers' interviews	2 teachers

Table 11: Overview of the preliminary survey

2.2. Results of the survey

This section highlights the main results of the preliminary survey. It is organized according to the three creativity dimensions explored in my research, i.e. process, product and teaching dimensions.

2.2.1. Process dimension: the game design process

The results of teachers' questionnaire regarding the game design process (see Annex 5.1) are summed up below.

a) Stage 1: task identification

At this stage, teachers engaged in the game design process. Results showed that their motivation to create their LGs was both intrinsic and extrinsic. Indeed, many teachers were personally interested in games *per se*, and wanted to go through the design process itself and master the topic. On the other hand, most of the participating teachers were highly motivated by the outcome of the design process, i.e. a new teaching resource which would be useful, engaging and attractive for their students, as well as "connect with the curriculum, enrich it, offering another way of learning" (Annex 5.1).

Before starting to design their games, teachers got the opportunity to consult some examples of LGs created with eAdventure, so to get an overview of the type of games that are possible to create. Results showed that this activity helped them to have an idea of the editors' functionalities and possibilities, and to know what they would be able to create: "it helped me to have an idea of what I could create" (Annex 5.1). One teacher even stated that he consulted classical examples of graphical adventure, so to have an idea of narrative dynamics.

b) Stage 2: preparation

Most of teachers (14 out of 16) considered the training received useful and sufficient in order to start the game design process. However, they mentioned that they needed more practice and support in order to achieve functioning games. In a teacher's words: "I needed to further explore the game editor's functionalities in order to go on with the development process. I would need further explanation on the tool, as well as more time" (Annex 5.1). Hence, they continued exploring the editor's functionalities after the training workshops.

The questionnaire enabled to elicit how teachers acquired the technical skills necessary to correctly manage the editor. However, further data was needed in order to identify the other skills and knowledge they considered useful to create their LG (i.e. knowledge about the domain), and the way in which they developed them.

c) Stage 3: response generation

Below I describe the results of the questionnaire regarding the different steps of the response generation stage.

- *Conceptualization:* teachers' ideas emerged according to different sources. First, exploring the affordances of eAdventure and consulting examples of LGs determined and conditioned their game ideas. Furthermore, they generated their ideas according to their specific pedagogical objectives, educational contexts and students' profiles. Finally, in most cases, ideas were determined according to external constraints, such as the time they could dedicate to the design process and the editors' limitations.

- *Elaboration:* most teachers found it useful to write a storyboard in order to concretize their ideas into a full consistent game. It facilitated their work, as it "served as a guide for developing the game" (Annex 5.1). Storyboards helped them to better plan and develop their game, as well as to modify the dynamics in a consistent way. Some teachers mentioned that they modified their storyboard all along the design process. Only two teachers stated that they preferred to work with the game editor from the beginning, as they felt more confident this way than writing a storyboard.

- *Production:* teachers considered the programing process to be time-consuming, frustrating, difficult, stressful and laborious.

These first results made me realize that further data was needed to understand in details the processes of conceptualization, elaboration and production, as well as the influences of intra-individual and environmental elements on these activities.

d) Stage 4: response validation

Results showed that most teachers continuously evaluated and adjusted their ideas and LGs through an iterative process. To do so, they often involved peers and asked for support to evaluate their games at different moments of the design process. Furthermore, in some cases, teachers involved their students in order to evaluate the adequacy of the LGs to the targeted audience. The involvement of others (i.e. peers and students) appeared as an important factor in the design process. Hence, I realized it would be relevant to further analyse this topic, as well as to collect more data on the collaborative game design processes at stake when teachers worked in teams.

In some cases, teachers kept their initial idea and adjusted it along the design process. On the other hand, 11 teachers out of 16 modified their game ideas and objectives according to two different criteria, i.e. feasibility and appropriateness. The former refers to time constraints and editors' affordances, while the latter looks at the value of the LGs regarding the teaching objectives. Further data was needed to better understand the criteria according to which ideas evolved during the design process.

e) Stage 5: outcome

Most teachers considered that they reached their objectives (i.e. to create an adapted LG, and to learn a new teaching methodology), and are satisfied with the result of the design process. In contrast, 3 out of 16 teachers considered that they did not reach their goal, but that they progressed towards it. Interestingly, in a teacher's words, "we reached our objectives of learning how to create a game and exploring the possibilities offered by eAdventure, but not creating a super game" (Annex 5.1).

Most teachers mentioned that their LGs could be applied to wider audiences and learning contexts. In contrast, some LGs were designed for specific target groups, and were considered to be "only valid in the context it was designed for" (Annex 5.1).

2.2.2. Product dimension: the LGs created

To evaluate the creativity of the LGs created by teachers, two aspects were analysed, i.e. usefulness and novelty.

a) Usefulness

Results suggested that some gaming aspects are appropriate in most LGs evaluated. Indeed, goals and rules are generally clear, so players know what they have to accomplish and how in order to complete the game. In contrast, results are more toned regarding feedback: most games enable the player to perceive the impact and consequences of her actions on the game world. However, all experts believe that feedback could be clearer and more consistent. Other items within the gaming aspects obtained lower scores, such as challenge, immersion, and entertainment.

Overall, pedagogical aspects were more positively evaluated than gaming ones. In general, experts considered that the pedagogical objectives in the LGs can be achieved easily and satisfactorily. In addition, games include sufficient resources to successfully achieve the learning goals. In contrast, experts considered that evaluation strategies should be given more importance and described in more details.

Regarding usability, experts highlighted concerns related to the use of icons and frequent interactions. For instance, an expert 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, instructions and menus.

b) Perceived novelty

Most teachers considered their LG to be innovative. Some argued that the created resources are different from the ones existing on the educational market. However, to some of them, the novelty character is related to their teaching practice, but not to the resources existing on the educational market.

2.2.3. Teaching dimension: application of the LGs

Data collected through observation and interviews with teachers provided insights regarding the teaching practices at stake during the GBL sessions.

The game sessions seem to have been effective considering the pedagogical goals set by teachers in their scenarios, as it was revealed during observations with students. Moreover, both teachers and students argued that the pedagogical objectives have been achieved more effectively through the game activity than with the methods they usually use. Indeed, the game activity was considered to be more engaging, so students felt more attentive with the game, and could learn without realizing it.

Some events in the sessions can be related to creative behaviours. Generally, teachers worked to maintain a psychologically safe and relaxed class environment. They spent most of the game session walking around the classroom checking whether students were finding their way through the game activity. In this context, a high level of autonomy for learning was achieved. When necessary, educators played the game on students' computer. Teachers appeared to be 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 game sessions, most students participated of them by smiling, laughing or sharing 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. Collaboration among students was also frequent during all GBL sessions. When students did not know what to do within the game, they usually asked for help to their classmates. They sometimes 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.

2.2.4. Conclusions of the preliminary survey

Questionnaires brought relevant results to understand the game design process from the perspective of creativity. Nevertheless, the need emerged for collecting more qualitative data in order to describe teachers' experience in details, according to their subjective perspectives. Hence, on the basis of these results, an interview protocol was designed, in order to deepen the following topics: the nature of the conceptualization, elaboration and production activities, the evaluation and adaptation of ideas along the design process, the intra-individual elements which acted on this process (i.e. the different types of task motivation, the domain-relevant skills necessary to undertake the design activities, and teachers' creativity-relevant processes), the influences of teachers' environment, the nature of collaborative design processes, and the involvement of students in game design activities.

Regarding the product dimension, questionnaires allowed for a broad evaluation of the LGs created by teachers. However, I decided to collect more qualitative data to obtain a detailed evaluation. To do so, I made the following decisions:

- Adapt the questionnaire into an interview, in order to collect the respondents' experience while playing the game. Hence, I decided to conduct walkthroughs with experts, so to ask them to talk through what they are thinking, and make them open-ended questions about gaming, pedagogical, usability and novelty aspects.
- Slightly adapt the criteria to be evaluated to determine the usefulness and novelty of the LGs (adaptations are explained in Chapter 4, Section 3.1).
- Collect experts' and students' perspectives on the novelty criteria, in order to triangulate data.
- Collect teachers' perspectives on the usefulness of their LGs, by conducting interviews with them.
- Collect students' perspectives on the LGs designed by their teachers, through a questionnaire which explores their level of enjoyment during the game session (Instrument 5).

Finally, regarding the teaching dimension, interviews and observations enabled to collect useful data and facts, as well as to detect some of the characteristics of creative pedagogies. On the basis of these broad results, I could define observation and interview protocols related to teachers' and students' experiences during the GBL activities. Furthermore, in order to obtain students perspectives on their playing experience, I decided to employ a questionnaire (Instrument 5).

3. Selection of cases

This section describes the units of analysis of the research, i.e. four groups of teachers, from three different Spanish educational centres (primary and secondary schools), who designed a LG. For each case, I present the different teachers of the group, their profile and teaching context, as well as the LG designed and its application in the classroom.

3.1. Case 1

This group of teachers was selected as a case for various reasons: first, teachers showed a high level of interest towards implementing innovative GBL methodologies. Members of the group participated in both the exploratory focus groups and the training workshops. Furthermore, they finalized the game design process, and completed their LG: *Alice's Trip*. Finally, following a maximal variation sampling, I selected this group as the designed LG was directed to students from upper secondary education. The next paragraphs present the group of teachers and their LG.

3.1.1. Profile of teachers

a) Composition of the group of teachers

Case 1 was composed of three school teachers from the centre IES de Sabón:

- *Teacher 1:* teacher in upper secondary education, humanities and social sciences (humanidades y ciencias sociales), first year. She has 22 years' experience teaching.
- Teacher 2: teacher in upper secondary education, economics of companies (economía de la empresa), second year. She has 25 years' experience teaching.
- *Teacher 3:* teacher in professional education, administration and finances (administración y finanzas). He has 26 years' experience teaching.

b) Teachers' experience with ICT-based methodologies

Teachers from Case 1 regularly use ICT-based teaching activities, including webquests, creation of classrooms' and students' blogs, sharing of resources and communication through Moodle platform, design of classrooms' websites, and use of interactive whiteboards. Hence, teachers are familiar with using educational technologies. This information comes from a pre-inscription form that teachers filled in before the training workshops (see Annex 3.1).

c) Teachers' experience with GBL methodologies

Before participating in the research project, teachers had little experience with GBL practices. Two of them (Teachers 1 and 2) mentioned that they had never used games for educational purposes. In contrast, one of the teachers had previously used basic game-based approaches in his teaching practice, through simple applications, in the area of mathematics.

c) Teaching context

The members of the group teach at the IES de Sabón, an upper secondary education centre located in Galicia region, which also provides intermediate vocational training. In total, the centre counts with 250 students. It is equipped with 45 computers. Furthermore, each classroom counts with two computers and an interactive whiteboard, and each student has its own laptop.

The IES de Sabón participates in a national educational project (Ponte Dos Brozos[67]), which aims to improve learning outcomes in the classroom through the integration of ICT-based methodologies.

[67] www.proyectopdb.org/

Teacher 3 is the coordinator of the project for the centre. Furthermore, the centre participates in the program 1x1 (one computer per child), and obtained several awards for educational innovations.

3.1.2. The LG Alice's Trip

Alice's Trip was created by teachers from Case 1. Figure 20 shows some screenshots from the LG. The game is available in Annex 4.1.1, and the related scenario in Annex 4.1.2.

Figure 20: Screenshots from the LG *Alice's Trip*

a) Pedagogical objectives

The LG *Alice's Trip* is directed to students from upper secondary education (humanities and social sciences, first year). It relates to the disciplines of history, geography, Latin and art history. It aims to make students familiar with the origins of their city (A Coruña, in Galicia region), acquire basic knowledge around Roman toponymy and Celtic culture, as well as refine their knowledge on history time periods.

b) Game plot

Alice is a Galician teenager who prepares her school exam. The game starts as she goes walking to the lighthouse Tower of Hercules in A Coruña city. There, she stops to rest a moment and, as in Lewis Carroll's novel's character, she starts dreaming and travels through different time periods of the history of A Coruña city. During her trip, Alice meets several characters and interacts with them.

Furthermore, she finds and uses different objects. All conversations and situations relate to local mythology, archaeology, legends, traditions and popular tales.

c) Game rules

The game objective is to help Alicia to go back home. To do so, she has to visit different scenes, corresponding to various places and times of the city. In each scene, she has to interact with characters and to correctly answer the questions they ask, each question having three possible answers. In contrast, if the player answers incorrectly, the character will reformulate the question. The player has the possibility to consult a virtual book (see Figure 20), which contains helpful educational content in order to answer the questions. The game ends when the player manages to bring Alice back to the present. Questions are part of a questionnaire, which serves for evaluating the knowledge acquired during the game. At the end of the game, students get a report stating the number of errors, as well as the time they used to complete each question.

d) Game genre

Following Whitton's taxonomy of games (2010), the LG comprises many elements from the adventure genre. Indeed, it includes a compelling narrative which uses fantasy elements (i.e. a time travel in which a girl gets to meet many characters from the history of Galicia.). Furthermore, the protagonist has to talk with many characters and collect different objects in order to complete her quest. Nevertheless, the question-answer dynamic relates to the puzzle category, which includes quizzes.

e) Complementary learning activities

Teachers have planned a series of pedagogical activities around the game. First of all, they planned a lecture through which students would review the different topics of the game, e.g. the history of Galicia and classicist literature. Students would also see videos related to the game topics and visit the Museum of Archaeology and History of A Coruña. Afterwards, students would play the game, in an individual manner, during a dedicated classroom session. Finally, teachers planned a debate through which students would talk about the questions raised in the game, and a visit of the Tower of Hercules lighthouse. Students would be evaluated on the basis of the report provided at the end of the game.

3.2. Case 2

This group was selected as a case for various reasons: first, teachers were interested in integrating GBL in their teaching practices. Furthermore, they achieved a complete LG: *Tuning up a Bicycle*. Finally, following a maximal variation sampling, I selected this group as the designed LG was directed to students from intermediate vocational training. The next paragraphs present the group of teachers and their LG.

3.2.1. Profile of teachers

a) Composition of the group of teachers

Case 2 was composed of two school teachers from the centre IES de Sabón:

- *Teacher 1:* teacher in upper secondary education, intermediate vocational training, for the subject "physical activities and sport in natural environments" (conducción de actividades físicas y deportivas en medio natural). He has 12 years' experience teaching.
- *Teacher 2:* teacher in professional education, in business and administration (administración y finanzas). He has 32 years' experience teaching.

b) Teachers' experience with ICT-based teaching methodologies

Both teachers from Case 2 regularly use ICT in their teaching practices. They mentioned that they used Moodle for enhancing a course of finances management, and that they organized wiki-based activities in which students elaborated and published their projects. Furthermore, they frequently involve students in searching for information on the Internet.

c) Teachers' experience with GBL methodologies

Teachers stated that they had very little experience with digital games. They only mentioned using JClic, an online platform for creating courses and exercises.

d) Teaching context

As for the Case 1, members of the group teach in the IES de Sabón. They also participate in the Ponte dos Brozos project.

3.2.2. The LG Tuning up a Bicycle

This section briefly describes *Tuning up a Bicycle*, the LG created by teachers from Case 2. Figure 21 shows some screenshots from the LG. The game is available in Annex 4.2.1, and the scenario in Annex 4.2.2.

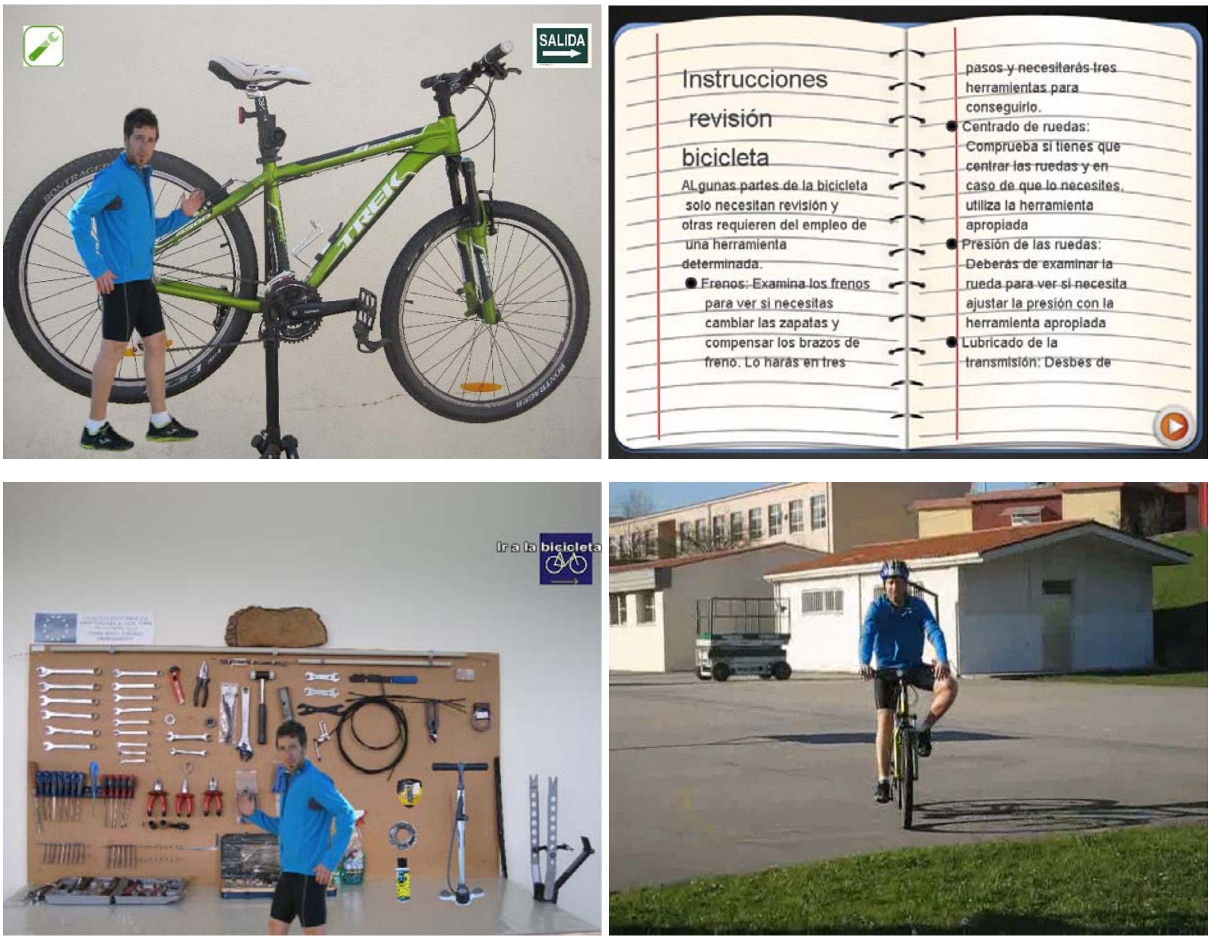

Figure 21: Screenshots from the LG *Tuning up a Bicycle*

a) Pedagogical objectives

The LG *Tuning up a Bicycle* is directed to students from upper secondary education (intermediate vocational training, subject “physical activities and sport in natural environments”). The pedagogical objectives are the following:

- To memorize the steps needed to tune-up the bicycle before going on a cycling tour;
- To review the appropriate tools for each adjustment task;
- To distinguish the different parts of the bicycle, and;
- To understand the importance of turning up the bicycle before going on a tour.

The game is thought to be used as a conclusion activity, after students have been introduced to the concepts taught, and applied these concepts through a hands-on session with a bicycle. Hence, the game is considered as a tool which would enable students to review and automatize contents, as well as to self-evaluate.

b) Game plot

The protagonist, a student of the vocational training program “physical and sports activities in natural environments”, would like to go on a bicycle ride tour. To do so, he enters the workshop of bicycles of his centre. There, he meets the repairman, who encourages him to check the different elements of the bicycle and to adjust what is needed in order to go on a safe tour. Following his advice, the student explores the different tools available to him and checks the different parts of the bicycle.

c) Game rules

The game objective is to check the 10 different components of the bicycle and to proceed to the necessary adjustments. To do so, the player can examine the different parts of the bicycle, and see which parts need to be fixed. Afterwards, he has to go to the tool desk, choose the necessary tools, and apply them to the parts of the bicycle to be fixed. According to his actions, the player will receive positive or negative feedbacks. Once he thinks he has finalized the revision process, he can choose to go on a ride. If all the components have been checked correctly, a video will be launched, in which the protagonist successfully runs the bicycle. In the contrary case, another video is launched, in which the protagonist falls off his bike. During the game, the student has the possibility to consult a manual which explains the different steps to tune-up a bicycle.

d) Game genre

The game possesses some characteristics from both the adventure and puzzle genres in Whitton's taxonomy (2010). As adventure games, it consists of manipulating objects in order to solve an objective, i.e. tune up the 10 different components of the bicycle. Nevertheless, the game seems to relate more to the puzzle genre. Indeed, it relates to combining different objects in the correct manner in order to solve a specific problem. Adventure games, in contrast, include more sophisticated narratives, and require the player to solve different tasks in order to achieve a larger quest.

e) Complementary learning activities

Teachers have planned a series of pedagogical activities around the game. First of all, a theoretical session is planned, in which the teacher would present the revision protocol to students. Second, teachers planned a hands-on session, in which students would practice the revision procedure in the bicycle workshop. Afterwards, students would play the game individually or in pairs, with the help of the teacher. Finally, a collective discussion would be conducted among students and the teacher. Evaluation is planned through an exam conducted after the game session.

3.3. Case 3

I chose this group of teachers as a case for the following reasons: besides of their curiosity towards GBL methodologies, members attended both the exploratory focus group and the training workshops. Furthermore, they completed their LG, *the HolyTorq*. Finally, following a maximal variation sampling, I selected this group as they were from a different centre than Cases 1 and 2, and the designed LG was directed to students from primary education. The next paragraphs present the group of teachers and their LG.

3.3.1. Profile of teachers

a) Composition of the group of teachers

Case 3 was composed of three school teachers from the centre CEIP Ponte dos Brozos:

- *Teacher 1:* primary school teacher. He has 30 years' experience teaching.
- *Teacher 2:* pre-school teacher. He has 27 years' experience teaching.
- *Teacher 3:* primary school teacher (students with special needs - language disorders). She has 30 years' experience teaching.

Furthermore, five teachers participated in some tasks of the design of the LG.

b) Teachers' experience with ICT-based teaching methodologies

Most of the teachers have many years of experience teaching with ICT. They have participated in various related courses. On a daily basis, they use ICT within the following activities:

- Development of the school and classrooms websites and blogs;
- Webquests, activities with Google Earth, use of digital documents, etc.;
- Use of the digital whiteboard.

c) Teachers' experience with GBL methodologies

Most of teachers from the team had very little experience with digital games. However, one of them mentioned having used similar resources in the classroom, i.e. interactive e-books.

d) Teaching context

The members of the group teach at the CEIP Ponte dos Brozos, a public school located in Galicia region which covers pre-school and primary education, including dedicated sessions for students with special needs. The school is equipped with a computer room with 35 computers. Moreover, each classroom counts with two computers. There are eight mobile computer rooms. Furthermore, the centre counts with digital whiteboards, tablets and projectors. All teachers have their own laptop. The centre widely uses ICT within the classroom activities.

As for Case 1, the centre participates in the Ponte dos Brozos project. Furthermore, it participates in the program 1x1 (one computer per child) and obtained several awards for educational innovations.

3.3.2. The LG the HolyTorq

This section describes *the HolyTorq*, the LG created by teachers from Case 3. Figure 22 shows some screenshots from the LG. The game is available in Annex 4.3.1, and the scenario in Annex 4.3.2.

Figure 22: Screenshots of the LG *the Holy Torq*

a) Pedagogical objectives

The LG *the HolyTorq* is directed to students from primary education (middle and superior cycles, aged from 8 to 12). It relates to the disciplines of knowledge of the natural, social and cultural environment (culture and habits) and Galician language. By introducing students to the everyday life in the Iron Age settlements, the game aims to raise students' awareness on the Galician traditions and on their cultural patrimony, as well as to expand their vocabulary on the topic.

b) Game plot

In the old Galicia from the Castro times, a young girl called Icía has to find a remedy to save her sick friend Keltoi, who has been hurt as he tried to recover the holy torq which was robed from the king Breogán. To do so, the girl follows the instructions of the druid. She goes through the fort and the forest in order to find mistletoe, which is part of the remedy. Afterwards, she explores the dolmen field and searches for the holy torq, which is hidden among other objects. She then goes back to the fort and gives the mistletoe to the druid, who prepares the remedy for Keltoi. Once he is healed, all the characters go and meet the king, and give him back the holy torq.

c) Game rules

In order to find Keltoi's remedy, Icía first has to explore the fort with her friend Brais and searches for three objects: a sword, to travel safe outside of the fort; a book, which will help her find mistletoe, and a sickle, to pick the plants. To do so, she has to distinguish objects and constructions from the Castro times. Once she finds the objects, she enters in the forest, in order to find mistletoe, with the help of the book, which provides information on different local plants. She has to recognize and differentiate various kinds of trees. Finally, Icía has to find the holy torq in the dolmen. To do so, she has to recognize different objects from the Celtic culture.

d) Game genre

Following Whitton's taxonomy of games (2010), the Holy Torq is an adventure game. Indeed, it includes a compelling narrative related to the Celtic culture and the Iron Age. The objective of the game is to solve a quest, i.e. to find a remedy to save Keltoi. To do so, the player undertakes a series of tasks (e.g. to find three objects, to find mistletoe, and to get back the holy torq), talks to different characters (e.g. the druid) and manipulates objects (e.g. a book and a sword) in order to find their way. Hence, the game mainly depends on mental agility.

e) Complementary learning activities

Teachers have planned a series of pedagogical activities around the game. First of all, they planned a lecture through which students would be introduced to the topics of the game, i.e. history of Galicia, and the local plants. Afterwards, Students would play the game, in an individual manner, during a dedicated classroom session. Finally, teachers planned a debate through which students talk about the topics raised in the game.

3.4. Case 4

This teacher showed a high level of motivation towards designing his own LG, *Masked Vinyl*. Even if he did not finalize it, he achieved a working prototype which presents interesting dynamics. Furthermore, following a maximal variation sampling, I selected this teacher as he designed his game in an individual manner. The next paragraphs present the teacher and his LG.

3.4.1. Profile of the teacher

a) Teacher from Case 4

Case 4 was composed of one primary school teacher from the centre CEIP Joan Llongueras, located in the city of Barcelona. He also teaches Music in a secondary school. He has 16 years' experience teaching.

b) Teacher's experience with ICT-based teaching methodologies

The teacher has a high level of experience in using ICT in educational settings. First, he does not use any text book in his class. Rather, his students use interactive and audio-visual resources. Furthermore, he has been training teachers in creating and using digital and 2.0 learning resources for three years, and participates in various related research projects related to ICT-based teaching methodologies.

c) Teacher's experience with GBL methodologies

The teacher considers himself a gamer. Before participating in the research, he had been using digital games with his students, through different modalities, i.e. LGs and commercial games repurposed for educational contexts.

3.4.2. The LG Masked Vinyl

This section describes the LG *Masked Vinyl*, which was created by the teacher from Case 4. The game was left at the status of a prototype, as all the scenes planned have not been programmed yet. Furthermore, the teacher wants to improve the interaction mode. That is why, the game has not been tested in real teaching settings. Figure 23 shows some screenshots from the LG. It is available in Annex 4.4.1, and the scenario in Annex 4.4.2.

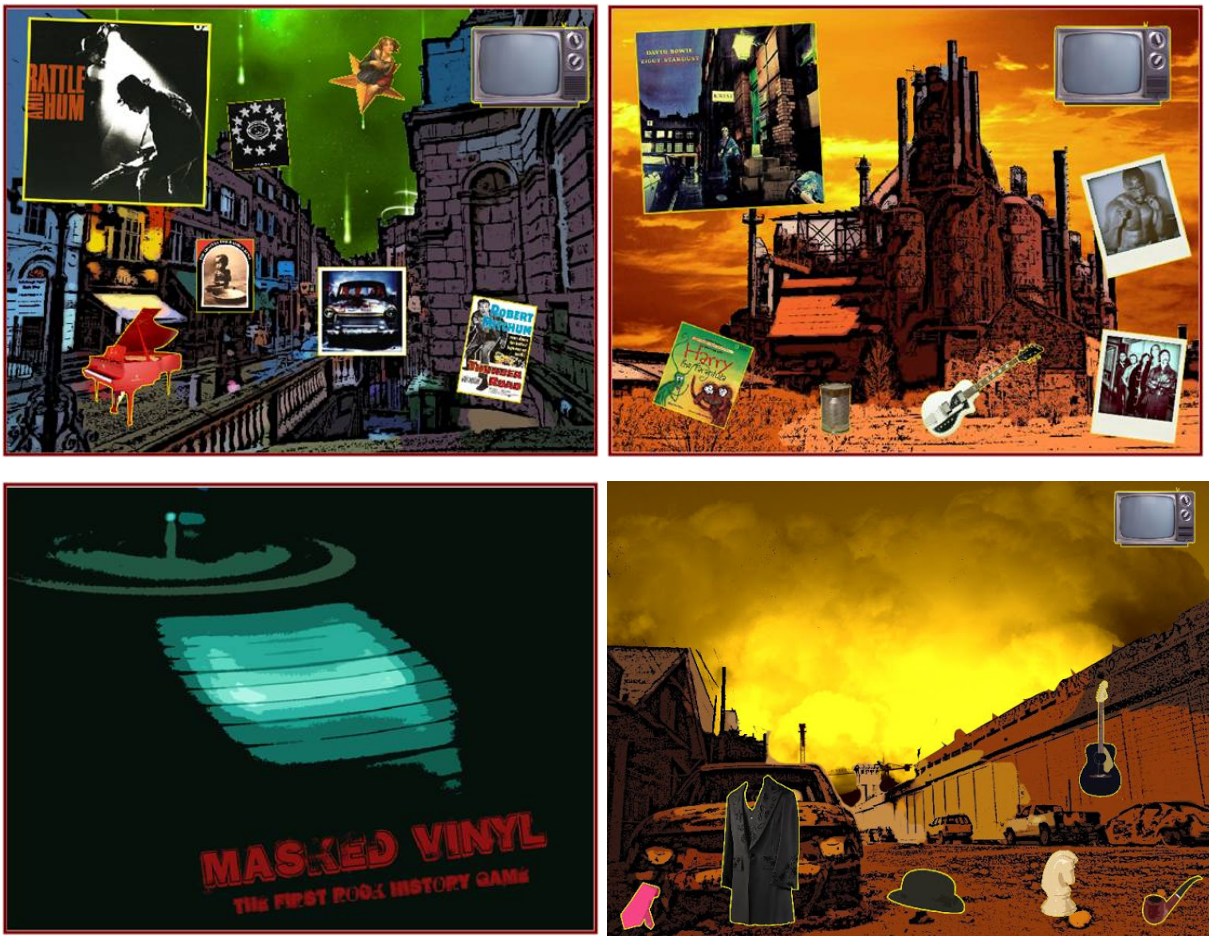

Figure 23: Screenshots of the LG *Masked Vinyl*

a) Pedagogical objectives

The LG *Masked Vinyl* aims to teach students from compulsory secondary school and non-compulsory secondary school about the history of Rock music. The pedagogical objectives are the following: (a) to browse the history of Rock by discovering elements of biography of some of its key-singers, songwriters and bands; (b) to learn about Rock history by hearing and watching artistic work in context; and (c) to read and understand texts in a foreign language in a communicative context.

b) Game plot

After the extinction of Rock and other key musical movements from the 20th and 21st centuries, the player (the game is first person) goes through several scenes, each of them corresponding to the musical environment of a key-artist or band in the history of Rock.

c) Game rules

In each scene, the player can interact with various objects (e.g. music instruments, clothing items, etc.) and must discern whether those objects belong to the musical universe of the artist or band. Once the valid objects are gathered, the player gets to hear one of the artists' songs, to watch the video of a concert, and to read more about their life. The player also gets a clue to discover the access the next game scene. In total, 20 scenes have to be solved in order to resuscitate Rock music.

d) Game genre

The game directly relates to the puzzle genre in Whitton's taxonomy. Indeed, it requires the player to explore and combine objects correctly in order to solve a series of puzzles related to the musical environments of different artists. Furthermore, the puzzles are embedded a larger narrative context, i.e. the extinction of the Rock music. The game depends on mental agility, and involves problem solving processes.

e) Complementary learning activities

The teacher has planned some learning activities around the game. Before the playing session, he planned some lessons in which students would learn about Rock artists and bands by listening to songs, watching videos, and searching for related content. Furthermore, students would express their musical preferences. During the game, students would play, either individually or in pairs. Afterwards, the teacher proposes an activity through which students would create a radio program for the school radio station, which resumes Rock history. Furthermore, he would like to involve students in the edition of the next scenes of the game, as a complementary learning activity.

3.5. Summary of cases

Table 12 displays demographic information for all teachers from the different cases, including the number of years they have been teaching, their gender, the discipline they taught, as well as their experience with games and ICT based teaching methodology.

Cases	Teachers	Years teaching	Discipline taught	Gender	Previous experience with GBL	Use of ICT-based teaching methodologies
Case 1	Teacher 1	22	Humanities	F	None	Interactive whiteboard, Blog, Moodle etc.
	Teacher 2	26	Economics of companies	F	None	Slight experience
	Teacher 3	25	Administration and finances	F	Use if basic game-based approaches	Moodle, webquests, Internet search, etc.
Case 2	Teacher 1	12	Physical activities and sport in natural environments	M	Game-like applications, e.g. JClic	Moodle, videos, etc.
	Teacher 2	32	Business and administration	M	Game-like applications, e.g. JClic	Moodle, Wikispaces
Case 3	Teacher 1	30	Primary school teacher	M	None	Websites and blogs, webquests, activities with Google-Earth, use of the digital whiteboard
	Teacher 2	27	Pre-school teacher	M	None	
	Teacher 3	30	Business and administration	F	Game-like applications, e.g. interactive e-books	
Case 4	Teacher	16	Primary school teacher and music teacher	M	Use of digital games in an educational contexts	Use of audio-visual resources, teacher training in creating 2.0 resources, participation in research projects related to ICT methodologies.

Table 12: Demographic information of the research's participants

4. Data collection procedures

Now that I have described the preliminary survey conducted in order to test the data collection strategy, as well as the different cases, I focus on the process of data collection. I present, for each dimension explored in the research, the instruments and procedures used in order to gather data.

4.1. Process dimension: educational game design

Hereby I describe the instruments and strategies used in order to analyse the process dimension.

Instrument 1: Teachers' interviews

I conducted interviews with the teachers from each case:

- One focus group with the three teachers from Case 1 (*Alice's Trip* LG);
- One focus group with the two teachers from Case 2 (*Tuning up a Bicycle* LG);
- One focus group with the three teachers from Case 3 (*the Holy Torq* LG);
- One interview with the teacher from Case 4 (*Masked Vinyl* LG).

All interviews were conducted in person, and recorded with respondents' permission. Transcriptions are available in Annexes 8.1.1, 8.2.1, 8.3.1 and 8.4.1.

Instrument 7: Document analysis

For each case, I examined different documents of interest to analyse the game design process:

- *Case 1:* I looked at the following documents: (a) the e-mail communication between teachers and the researcher during the design process, (b) the storyboard of the LG *Alice's Trip*, and (c) the article and poster written by teachers for the GACET'11 conference, which describe the game design process.
- *Case 2:* I examined the e-mail communication between teachers and the researcher during the design process. Teachers did not write any storyboard or article.
- *Case 3:* I looked at the following documents: (a) the e-mail communication between teachers and the researcher during the design process, (b) the storyboard of the LG *the Holy Torq*, and (c) the article and poster written by teachers for the GACET'11 conference.
- *Case 4:* I examined the following documents: (a) the e-mail communication between teachers and the researcher during the design process, (b) the storyboard of the LG *Masked Vinyl*, and (c) the article and poster written by teachers for the GACET'11 conference.

All documents are available in Annexes 8.1.7, 8.2.7, 8.3.7 and 8.4.5.

4.2. Product dimension: the LGs created

Hereby I describe the instruments and strategies used in order to examine the product dimension.

Instrument 2: Experts interviews

For each case, I conducted interviews with experts in the field of GBL in order to evaluate the corresponding LGs. I carefully selected several experts according to their academic background and their field of action. I contacted them to organize a meeting, and randomly assigned them a LG they would evaluate. The idea was to have each LG evaluated by two experts, except for *Masked Vinyl*, which was still at the status of prototype, and was evaluated by one expert only.

During the meeting, I introduced experts to the research objectives, invited them to carefully read the GBL scenario related to the LG I had assigned to them, as well as to play the game for about 20 minutes. I invited them to think aloud during the game session, while I was observing and taking some notes. Afterwards, I conducted the interview. In total, seven interviews were conducted. Interviews were tape recorded with permission. Transcriptions are available in Annexes 8.1.2a, 8.1.2b, 8.2.2a, 8.2.2b, 8.3.2a, 8.3.2b and 8.4.2.

The following paragraphs describe the distribution of expert per cases.

Case 1

To evaluate the creativity of the LG Alice's Trip, I conducted interviews with the following experts:

- *Pere Nolla:* he is an expert in design of interfaces, usability, mechanics, and gameplay, with more than five years of experience in the design and management of digital games. He teaches in the Master of Creation of Videogames (University Autònoma of Barcelona);
- *Imma Marín:* she is an expert in games, entertainment, and new technologies in education. She is the director of the Marinva company, which creates interactive media projects for children and youth. She is also the president of IPA Spain (International Play Association) and founder of Atzar· the Association of ludotecaris of Catalonia).

Case 2

I conducted interviews with two different experts in order to explore the creativity of the LG *Tuning up a Bicycle*:

- *Juan Abadia:* he is a telecommunications engineer. He is a lecturer in the Department of Technology of Pompeu Fabra University, and programmer at the Novarama Technology company, which develops digital games.

- *Mireia Usart:* she is a fellow at the Direction of Educational Innovation and Academic Quality in ESADE Law & Business School (Barcelona). Her main interest is on students' time perspective in GBL activities, in the context of blended learning for adult learners.

Case 3

To evaluate the LG *the Holy Torq*, I conducted interviews with two different experts:

- *Tere Vida:* she is an expert in games, education and new technologies. She was a project manager in the Marinva company. She also advises companies and entities, as well as gives talks, workshops and conferences on digital games and education.
- *Oscar García:* he has a PhD from the "Intelligent Systems and Distributed parallel environments" program at La Salle University (Barcelona). He is the director of the Multimedia Engineering Degree and the Multimedia Creation, Design & Engineering Master Program, and teaches Virtual Reality to future engineers. Furthermore, he collaborates with the Entertainment Technology Centre at Carnegie Mellon University (Pittsburgh, PA, USA) as a faculty advisor.

Case 4

To evaluate the creativity of the LG *Masked Vinyl*, I conducted an interview with Oscar García (see profile above).

Table 13 illustrates the distribution of LG per expert.

	Alice's Trip	Tuning up a Bicycle	the HolyTorq	Masked Vinyl
Pere Nolla	X			
Imma Marín	X			
Juan Abadia		X		
Miereia Usart		X		
Tere Vida			X	
Oscar García			X	X

Table 13: Overview of the expert evaluations conducted for each LG

4.3. Teaching dimension: application of the LGs in the classrooms

Hereby I describe the instruments and strategies used in order to analyse the teaching dimension.

Instrument 3: teachers' interviews

I conducted interviews with the teachers from each case:

- One interview with one teacher from Case 1 (*Alice's Trip* LG).
- Two interviews with the two teachers from Case 2 (*Tuning up a Bicycle* LG).
- Two interviews with two teachers from Case 3 (*the HolyTorq* LG).
- One interview with the teacher from Case 4 (*Masked Vinyl* LG).

All interviews were conducted in person, and recorded with respondents' permission. Transcriptions are available in Annexes 8.1.3, 8.2.3a, 8.2.3b, 8.3.3a, 8.3.3b and 8.4.3.

Instrument 5: students' questionnaires

I distributed questionnaires to all students who participated in the game sessions:

- *Case 1:* 13 students filled in the questionnaire after having played the LG *Alice's Trip*.
- *Case 2:* 12 students filled in the questionnaire after having played *Tuning up a Bicycle.*
- *Case 3:* 38 students filled in the questionnaire after having played the LG *the HolyTorq*.
- *Case 4:* no questionnaires were filled in, as *Masked Vinyl* has not been used in real teaching settings yet.

Permissions to parents were requested by teachers on my demand. Questionnaire results are available in Annexes 8.1.5, 8.2.5 and 8.3.5.

Instrument 6: observations

During game sessions in the classrooms, I performed observations of students and teachers learning and teaching practices:

- *Case 1:* I observed one game session of *Alice's Trip*, involving one teacher and 13 students from first year of post-compulsory secondary school (age 16);

- *Case 2:* I observed one game session of *Tuning up a Bicycle*, involving two teachers and 12 students from first year of professional training (age 16-17);
- *Case 3:* I observed one game session of *the HolyTorq*, involving three teachers and 20 students from 5th grade of primary education (age 10-11);
- *Case 4:* no observation was performed, as *Masked Vinyl* has not been used in real teaching settings yet.

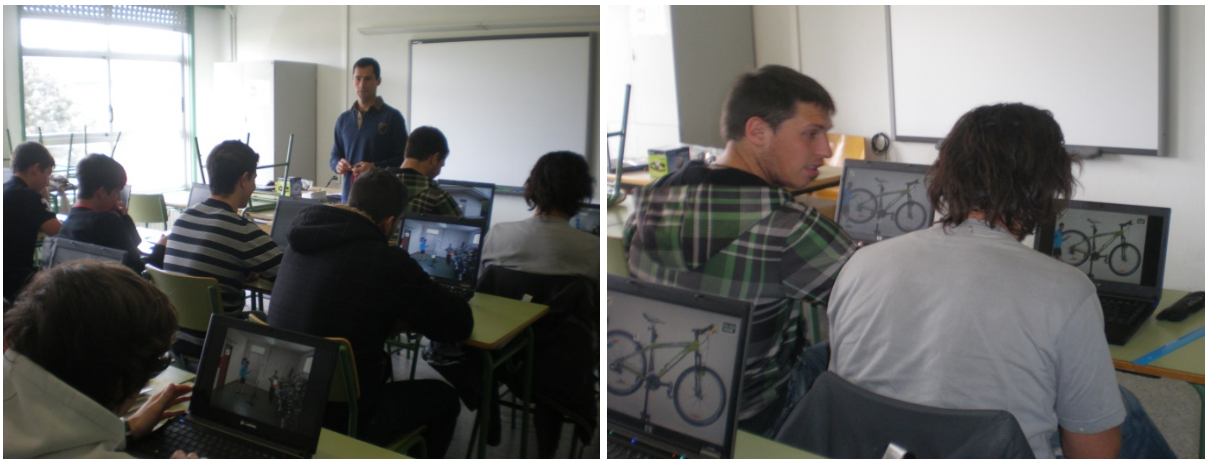

Figure 24: Picture from the classroom observation for the LG *Tuning up a Bicycle*

Figure 25: Picture from the classroom observation for the LG *the Holy Torq*

Observation reports are available in Annexes 8.1.6, 8.2.6 and 8.3.6.

Table 14 summarizes the instruments used for each case, in order to answer the different sub-questions of the research.

Research questions	Instruments	Case 1	Case 2	Case 3	Case 4	Total
SQ1: Process dimension	Teachers' interviews / focus groups	3	2	3	1	**9**
	Documentation	51 e-mails / 1 article, 1 poster, 1 storyboard	4 e-mails	23 e-mails, 1 article, 1 poster, 1 storyboard	12 e-mails, 1 article, 1 poster, 1 storyboard	**N/A**
SQ2: Product dimension	Expert interviews	2 experts	2 experts	2 experts	1 expert	**7**
SQ2 / SQ3: Product / teaching dimensions	Teachers' interviews	1 teacher	2 teachers	2 teachers	1 teacher	**6**
	Students questionnaire	13 students	12 students	38 students	0	**63**
SQ3: teaching dimension	Observation form	1 classroom of 13 students and one teacher	1 classroom of 12 students and 2 teachers	1 classroom of 20 students and 1 teacher	0	**3 classrooms of 45 students and 4 teachers**

Table 14: Overview of the data collection process

5. Data analysis process

After having collected data, I proceeded to its analysis. To do so, I followed several steps, i.e. I first prepared data from the different survey instruments and then explored and coded it, until arriving to a series of themes, which later guided my interpretation.

5.1. Preparing data for analysis

This section presents the procedures I followed in order to prepare data collected from the different survey instruments, i.e. interviews, observations and questionnaires.

5.1.1. Interviews, observations and documents

First, I organized data collected into computers files, and grouped them into folders. Afterwards, I converted interviews' audiotape recordings and observations' field notes into text data. I preferred hand analysis, in order to keep close to data and to have a hands-on feel for it, by manually sorting, organizing, and locating words in the text.

5.1.2. Questionnaires

Regarding students' questionnaires, I first scored the data, i.e. I assigned a numeric value to each response given by students, in the following manner: 5 for "strongly agree", 4 for "agree", 3 for "neither agree nor disagree", 2 for "disagree", and 1 for "strongly disagree". Afterwards, I examined the database for missing data. It appeared that, in some rare cases, students omitted a few questions. In these cases, I attributed the score 3 ("neither agree nor disagree"), so to have a neutral value which would not alter the overall statistical findings (Creswell, 2012).

Once data was ready, I used descriptive statistics to summarize the overall trends in data, and provide an understanding of how varied the scores were. To indicate general tendencies in data, I calculated the means, modes and medians for the whole set of items, as well as for each factor (i.e. challenge, goal clarity, feedback, autonomy, concentration, immersion, social interactions, knowledge improvement, and innovation). To analyse the spread of scores, I calculated the variances and the standard deviations (SD). Detailed strategies of calculations are available in Annexes 8.1.5, 8.2.5 and 8.3.5.

As for teachers' questionnaires, I analysed data according to qualitative procedures. The data analysis consisted in analysing different scopes: among participants (i.e. comparing scores on the same phase from different participants) and within participants (i.e. comparing scores on different phases from the same participant).

5.2. Exploring and coding data

After having prepared data, I first performed a preliminary exploratory analysis (Creswell, 2012), by reviewing data several times, in order to immerse and obtain a general sense of it, reflect how to organize it, and create first ideas and concepts around it. Afterwards, I started to code data. Creswell (2012) describes data coding as an "inductive process of narrowing data into a few themes" (p. 243). Indeed, I divided text data into different segments of information, and labelled these segments in codes. Then, I examined these codes, made sure to eliminate overlap and redundancy, and reduced them in order to narrow data into themes. Afterwards, in order to add additional rigor, I organized themes and sub-themes into different layers, from broad themes to more detailed ones, deepening into the meaning of each main themes. Furthermore, I interconnected them to highlight the relations between the different themes.

Tables 15, 16, and 17 present the systems of interconnected themes for each dimension explored through my study (i.e. process, product, and teaching).

The internal coding served to identify the different themes. I established codes on the basis of alphanumeric digits, i.e. (a) numbers attributed according to the hierarchy semantically occupied by the themes in the different layers; and (b) letters corresponding to the first letters of the themes. For example, the theme "Game Design Stages", pertaining to Layer 1, was attributed the code "1GDS".

Themes explored		
Layer 1	**Layer 2**	**Layer 3**
Game design stages (1GDS)	Stage 1: task identification (2TI)	Engagement in the task (3ET)
		Definition of the pedagogical objectives (3DPO)
	Stage 2: preparation (2PRE)	Domain-relevant skills (3DRS)
		Learning processes (3LP)
	Stage 3: response generation (2RG)	Conceptualization (3CONC)
		Elaboration (3ELAB)
		Production (3PROD)
	Stage 4: response validation (2RV)	Response validation criteria (3RVC)
		Response validation strategies (3RVS)
	Stage 5: outcome (2OUT)	Outcome evaluation (3OE)
		Communication (3COMM)
Collaborative game design (1CGD)	Group members (2GM)	Group history (3GH)
		Members' profiles (3MP)
	Group processes (2GP)	Legislation (3LEG)
		Distribution of tasks (3DT)
		Leadership (3LEAD)
		Members communication (3MC)
		Members relationships (3MR)
	Advantages of collaborative game design (2ACGD)	
	Challenges of collaborative game design (2CCGD)	

Table 15: System of themes for the process dimension

LAYER 1	LAYER 2	LAYER 3
Usefulness (1USE)	Gaming aspects (2GA)	Clarity of goals (3GOALS)
		Balance of difficulty (3DIFF)
		Clarity and constancy of feedback (3FEED)
		Clarity and consistence of rules (3RULES)
		Immersion (3IMMER)
	Pedagogical aspects (2PA)	Clarity of pedagogical objectives (3CPO)
		Connection to the curriculum (3CURRI)
		Alignment of game play and pedagogical objectives (3ALIGN)
		Appropriateness to the profile of students (3APPRO)
		Planning of complementary activities (3ACTI)
		Pedagogical evaluation (3EVAL)
		Adequate use of documentation resources (3DOCU)
		Planning of necessary resources (3RES)
		Attention to diversity (3DIV)
	Usability aspects (2UA)	Easiness of use (3EAS)
		Minimization of errors and dead points (3ERR)
		Easiness of installation (3INSTAL)
		Compatibility (3COMPA)
		Accessibility (3ACCES)
Novelty (1NOV)	Little-c creativity (2LCC)	Teachers (3TEACH)
	Middle-c creativity (2MCC)	Students (3STU)
		Educational centre (3EC)
	Big-C creativity (2BCC)	Existing learning resources (3ELR)
		Existing games (3EG)

Table 16: System of themes for the product dimension

LAYER 1	LAYER 2	LAYER 3
Teachers' experience (1TE)	Organization of the GBL activities (2ORG)	
	Role during the game session (2RGS)	
Students' experience (1SE)	Engagement (2ENG)	Immersion (3IMM)
		Concentration (3CONC)
		Autonomy (3AUTO)
		Social interactions (3SI)
	Achievement of the pedagogical objectives (2APO)	

Table 17: System of themes for the teaching dimension

As seen in the conceptual framework, teachers' creativity was explored through the analysis of these three dimensions. Furthermore, with the aim of validating this analysis, I also collected teachers' perspectives on creative pedagogies through interviews.

The next chapter provides a detailed description of each of these themes.

SUMMARY OF THE CHAPTER

This chapter described the different stages of the research, which consisted of the application of the stages of educational game design (implemented through teacher training and game design activities), a preliminary survey conducted during the application of LGs in the classroom, the selection of cases, data collection and analysis procedures. The next chapter provides a detail description of the results of the analysis, for each of the four cases studied.

Chapter 6

Data analysis

Introduction

This chapter describes the analysis of data collected through the different instruments and strategies employed in the study (i.e. interviews, questionnaires, documents and observations). It consists of a narrative discussion about the different themes established with regards to teachers' creativity within the design and application of LGs.

The discussion is interpretive, as it brings my own perspective on the data collected. Nevertheless, it intends to reflect teachers' experience as faithfully as possible. To do so, it includes dialogues and quotes from the research participants, which capture their feelings and perspectives on the experience. It also attempts to report multiple perspectives on the phenomenon studied, by providing the views of different individuals and sources of information. Quotes were translated into English, in order to ease reading. The original quotes are available in the interviews transcriptions, available in Annexes 8.

The chapter successively presents the analysis performed for each case study, according to the dimensions explored in the study (i.e. process, product, and teaching) and the themes identified in Chapter 5. Afterwards, it presents a brief synthesis of the specificities of the four cases.

1. Case study 1: design and application of the LG Alice's Trip

This section analyses the design and application of the LG *Alice's Trip* (Annexes 4.1) by the group of teachers from Case 1, from the IES Sabón educational centre.

1.1. Process dimension

Hereby I describe, from the perspective of creativity, the process through which teachers from Case 1 designed the LG *Alice's Trip*. The discussion presents the game design process according to the model of stages established in the conceptual framework. Furthermore, it describes the influences of the person (intra-individual components, i.e. task motivation, domain-relevant skills and creativity-relevant processes) and press (the available resources, the curriculum and the social environment) dimensions on each of the stages. Afterwards, it focuses on the collaborative processes at stake among teachers during the game design process. The discussion is mainly based on teachers' interview (Annex 8.1.1). In addition, it takes into account teachers' questionnaire results (Annex 8.1.4), and game design documentation (Annex 8.1.7).

1.1.1. Game design stages (1GDS)

In Chapter 3 (p. 80), I identified a model of stages for creative educational game design, adapted from different models from the GBL and creativity literature. The following paragraphs describe teachers' experience at each of the stages.

a) Stage 1: task identification (2TI)

This stage consisted, for teachers, of engaging in the task and identifying the pedagogical objectives of their game. The next paragraphs describe this process in details for teachers from Case 1.

Engagement in the task (3ET)

Teachers actively participate in the Ponte dos Brozos project. One of them, Teacher 3, coordinates the initiative. In the context of the project, he heard about the possibility of participating in the study, and attended the focus groups which were conducted during the exploratory study. There, he learnt about the research approach (i.e. the design and application of LGs by teachers) and the main affordances of the eAdventure game editor. The teacher considered the research approach relevant to his centre's methodologies, and informed his colleagues about the possibility of participating. Among others, the two other teachers from Case 1 decided to take part.

Hence, teachers' social environment, more specifically the educational centre (through its participation in the Ponte dos Brozos project), determined teachers' participation in the project. As stated by Teacher 1, "everything started through the Ponte dos Brozos project" (Annex 8.1.1).

Data analysis showed that different types of motivation pushed teachers in engaging in the game design process. First of all, they decided to design their LG in order to discover innovative teaching methodologies. Indeed, they wanted to "get to know and experiment new teaching tools" (Annex 8.1.1). Furthermore, as Teacher 2 puts it, "I wanted to work on other disciplines than mine" (Annex 8.1.1). Second, teachers aimed to enhance their students' motivation. Indeed, to them, "games are valuable teaching tools, because they are fun and can boost students' attention and interest for learning" (Annex 8.1.4). They also believed that digital games have a potential to increase learning outcomes. In addition, teachers perceived GBL as a resource specially adapted to their disciplines. As mentioned by Teacher 1, "this tool seems very powerful and can offer multiple possibilities in my disciplines. It can be useful for studying the epic stories of heroes like Ulysse or Eneas, for studying topics of history, traditions, mythology and art history" (Annex 2.1). Furthermore, as Teacher 2 puts it: "the disciplines we teach can be enhanced by new technologies, history and geography, need to be modernized and attractive" (Annex 8.1.1). As a result, teachers considered GBL as a useful methodology for their contexts and students. Finally, Teacher 1 mentioned that challenge motivated her in undertaking the task: "I decided to do it because it seemed difficult, and I thought I would not be able to do it, but I wanted to take the challenge" (Annex 8.1.1).

Hence, different types of motivation determined teachers' decision in engaging in the game design process, i.e. intrinsic (for the sake of the challenge of the task, and to discover new teaching methodologies) and extrinsic (obtaining an effective resource which would match the subject taught, enhance students' motivation, and reach high learning outcomes).

Regarding creativity-relevant processes, teachers' openness to experience (i.e. they were interested in experimenting and discovering new methodologies) and interest in the domain (i.e. GBL) encouraged their participation in the research. As stated by Teacher 2, "I wanted to innovate and learn new things" (Annex 8.1.1).

Definition of the pedagogical objectives (3DPO)

During a brainstorming conducted in the centre among teachers who wanted to create their LGs, the members of the group decided to work together. Indeed, they realized that had common objectives and complementary competences. They decided to relate the educational objectives of the game to the disciplines taught by Teacher 1 (history, geography and mythology) and students (first year of upper secondary education, humanities and social sciences), as the teacher thought that her topics would possibly be enhanced by GBL methodologies. Furthermore, Teacher 2 showed a high level of interest in this subject, although she teaches Economics.

b) Stage 2: preparation (2PRE)

This stage consisted, for teachers, in building domain-relevant skills, i.e. skills and knowledge necessary for undertaking the game design task. On the basis of teachers' perspectives, I describe below the different types of knowledge and skills that teachers acquired, as well as the nature of this learning process.

Domain-relevant skills (3DRS)

First, teachers had to acquire different types of technical skills in order to be able to implement their ideas in a working game. On one hand, they learnt "technical skills to manage the editor" (Annex 8.1.1). In addition, Teachers 1 and 2 had a low level of ICT literacy at the outset of the design process. Progressively, they acquired a variety of technical skills, such as sound and picture edition, in order to elaborate the game's audio-visual resources.

Second, teachers asserted that they had the opportunity to learn how to work in team, i.e. to be flexible with others' work, to synchronize, to consider others' ideas and to integrate different perspectives in a common work (Annex 8.1.1). Indeed, they designed their LG in a collaborative manner, with the different members of the team, but also involving other people of the educational community, such as colleagues, students, and the city council of their city. As expressed by Teacher 1: "the competence we developed, and that we didn't have, was to work as a team, like we had never done before. It was not only the team of the game, but we extrapolated it to the community, the students, that is, we tried to involve everyone, and the truth is, it worked" (Annex 8.1.1).

As Teacher 1 was expert in the game topic, the team had the sufficient knowledge to start designing the learning content of the LG. Nevertheless, as the game evolved, the contents to be included became more and more specialized and complex. As a result, teachers had to search for factual knowledge about the domain (i.e. the history of A Coruña city), as well as check it and complete it. As argued by Teacher 3, "new things appeared, which we didn't know and which were part of the history of the city" (Annex 8.1.1).

Learning process (3LP)

Teachers learnt the main functionalities of eAdventure during the training workshops. Furthermore, they continued exploring the software afterwards, in an autonomous manner, as they were working on their game. This self-regulated learning process enabled them to discover new functionalities, "according to what the game was asking" (Annex 8.1.1), all along the design process. In addition, they often asked support to the researcher (Annexes 8.1.4 and 8.1.7). Hence, technical skills were mastered little by little, on a problem solving basis, as teachers progressed and the game was evolving. Teachers mentioned that technical skills were the most difficult and time-consuming to master. Indeed, they described the editor as "complicated to learn" (Annex 8.1.1).

As for factual knowledge about the domain, teachers acquired the necessary information to complete the content of their LG through an "investigation process" (Annex 8.1.1): they consulted books, searched in the Internet, and asked for information to different actors from their social environment, i.e. colleagues and actors from the local civic and cultural institutions (museums and the city council). Teachers stated that they found "collaborative people" (Annex 8.1.1) who provided a valuable help to find information. In addition, they sometimes directly searched for information *in situ*, i.e. on the sites that appear in the game. As stated by Teacher 2: "what we didn't find in the Internet, in books or with colleagues, we had to search for it in the real world" (Annex 8.1.1). This aspect of the design process, which they called "fieldwork", was considered to be pleasant and rewarding. As expressed by Teacher 1, "what I preferred was the fieldwork. I didn't know that we would have to do fieldwork, it was the most rewarding part" (Annex 8.1.1).

Hence, the acquisition of domain-relevant skills consisted of an iterative, progressive process, which took place all along the development of the game. In the words of Teacher 3, "we first learnt in a formal way, during the training, and then in an informal way, when we searched for the information spontaneously, when we needed it" (Annex 8.1.1). Teachers learnt in a contextual manner, at the pace of their game, and according to the needs of its development. As Teacher 1 puts it, the game "was asking what it needed" (Annex 8.1.1).

c) Stage 3: response generation (2RG)

On the basis of the previous stages, teachers generated ideas and responses to create their LGs, through several design activities. I describe, in the next paragraphs, the processes of conceptualization, elaboration and production of the LG *Alice's Trip*.

Conceptualization (3CONC)

As mentioned earlier, the team decided to create a game related to the disciplines taught by Teacher 1, i.e. history, geography and mythology. They aimed to address a topic which could transversally integrate these different disciplines (Annex 8.1.4). In addition, they wanted to develop a game around the Tower of Hercules lighthouse, which had just been named as patrimony of humanity (Annex 8.1.1).

On this basis, Teacher 2 started to prepare ideas, and wrote a first plot which she presented to her colleagues. It was related to the story of Alicia, a young student who falls asleep while preparing her school exam, and travels, in her dreams, in the different periods of the history of A Coruña city. The other teachers directly validated the game idea, as they considered it feasible and relevant. The dialogue below resumes the initial process of idea generation (Annex 8.1.1):

Teacher 2: We had a meeting for brainstorming, and we agreed on working together. From there, during a week-end, I started to think. And what I thought was, I like a lot history, geography, and it's a field I don't master, but [Teacher 1] does. And [Teacher 3] is the technical one. So I thought of doing the game on the environment of Arteixo. But we didn't have enough material. And I thought about the Tower of Hercules, which is the oldest lighthouse in the world.
Researcher: [pointing at Teachers 1 and 3] And you liked the idea?
Teacher 1: What else could we do! [laughs]
Teacher3: The truth is that she sold it very good!
Teacher 1: She came with a draft.
Teacher3: The idea already had a name.
Teacher 1: I think you brought the girl, the first scenes, everything!
Teacher 3: It sounded quite attractive.
Teacher 1: We thanked her for bringing the idea, for me it's the most difficult.
Teacher 3: And besides it was quite directed to where we wanted to go.

Hence, the initial process of idea generation occurred according the following elements:

- *The curriculum:* the topic was chosen to support the subjects taught by Teacher 1, i.e. history, geography and mythology.
- *Teachers' domain-relevant skills:* the game idea was determined according to the expertise of Teacher 1 in history, geography and mythology.
- *Learning opportunities:* as for Teachers 2 and 3, they showed a special interest in learning about the game topics: "it enabled us to discover many things we normally don't touch" (Annex 8.1.1).
- *Teachers' interests:* as a result, the game idea had the potential to fulfil the interests of the different members of the group. In the voice of Teacher 2: "with this idea, we could create a lot of synergy, we could join interests" (Annex 8.1.1).
- *Teachers' creativity-relevant processes:* the first ideation process was determined by Teacher 2's "huge flow of ideas" (Annex 8.1.1). This refers to an appropriate cognitive style for generating novel ideas. Teacher 1 described her colleague's ability: "imagine you have to find a title for a novel: [Teacher 2] is the one who will quickly find it. And she gets it right, and we told her. So, she gets the idea, and besides, the idea is viable" (Annex 8.1.1).
- *Available resources:* the topic was chosen according to the resources which were available to teachers in their city.
- *The editor's affordances:* the specificities of the software impacted on the game idea. Indeed, Teacher 2 voiced that "given the editor, it was clear that the game had to be a time travel" (Annex 8.1.1).

Teachers followed this same idea all along the design process, as a "point of anchorage" (Annexes 8.1.4 and 8.1.7).

Elaboration (3ELAB)

According to their initial idea, teachers defined the educational contents, game elements and dynamics of their game.

The elaboration of the plot occurred in a progressive, natural manner, according to the pace of the game. Teachers considered the experience "as an open creation" and "were attentive to what the game was asking" (Annex 8.1.4). The game idea grew up "on its own", and evolved "like a human being" (Annex 8.1.4). As mentioned by Teacher 2, "we first created the character. The character is contemporary, so we started in a determinate site, and this site indicated us that we had to start with mythology. Each site leads to some stories, characters and objects. Everything was done is this manner. The game itself was leading us". Hence, response possibilities were generated according to a blind and random process.

The elaboration of contents was considered to be time-consuming and complex. Indeed, the game addressed various disciplines and areas of knowledge. Teachers first determined the content of their LG. As expressed by Teacher 1: "there were too many disciplines, too many fields, I mean, we wanted to address so many branches: anthroponomy, art, mythology, history. It was quite complicated" (Annex 8.1.1). Hence, this part of work helped her to better perceive the connections among these topics, and transmit them to her students, by making content more flexible. In her words, "I realized that, although it means more efforts, making content more flexible, distorting them and dislocating them, according to each course and each student, is much more useful" (Annex 8.1.3).

Afterwards, teachers adapted and organized contents according to students' profile and level of knowledge. In the words of Teacher 2, "we tried to include content that they [students] have not studied, that is new to them. That was the most difficult: organize all this information, so that they learn".

Teachers elaborated their game in a detailed storyboard (Annex 8.1.7). This document described the plot, the objectives, as well as the characters, the objects and the settings of the game. Furthermore, it presented each scene of the game, including information related to the characters of the scenes, the learning content, and a description of the actions conducted by the player. Furthermore, the storyboard contained the dialogues among characters, as well as the questions of the game. The document evolved all along the design process, i.e. content was adapted and completed as teachers learnt new elements about the topic and received feedback from external persons, i.e. peers, students, and the researcher. As explained by Teacher 2, it contained "a draft from each scene, which included the links and the characters. On this basis, we have acquired more information, we refined it, and we added things. We checked elements we were not sure about, through the Internet, or through books" (Annex 8.1.1). Teachers frequently asked for support, in order to know whether what they planned in the storyboard was feasible. They received help for detailing the different elements of the game, and avoiding planning interactions which would have been too complex to program (Annex 8.1.7).

To teachers, the storyboard acted as a "guide for the design process" (Annex 8.1.4). It helped them to concretize their ideas, by defining them and refining them in parallel with the other elements which compose the game, and with the actions of the player. Furthermore, they could see whether those ideas were feasible or not. Finally, it enabled them to plan the further step of the design process, i.e. the production of the game.

Production (3PROD)

After having finalized the storyboard document, teachers determined the different graphical and audio resources which would give life to their game. They used different types of resources:

- Graphical resources found on the Internet;
- Pictures made by teachers on the field;
- Audio resources created by recording students' or colleagues' voices: "characters are students, or teachers" (Annex 8.1.1);
- Graphical resources created by a professional graphic designer.

This aspect of the design process was part of the "fieldwork", and was particularly enjoyed by teachers. Indeed, they had to go to the sites and interact with different actors from local cultural institutions. In the words of Teacher 1, "we had to go and take pictures, walk the streets of the city, the museums, ask for permissions to the administrations so they let us in the sites and take pictures. Collaboration, this was the most pleasant" (Annex 8.1.1). Furthermore, teachers' educational centre played a determinant role, as it provided economical resources to the team to contract a graphic designer. As expressed by Teacher 2 when referring to the institution, "collaboration 100 per 100" (Annex 8.1.1).

The production step also consisted of integrating the audio-visual resources and programming the interaction system with the eAdventure editor. Teachers considered this aspect the most difficult and time-consuming of the design process. Indeed, managing the editor's functionalities required a high amount of learning. Furthermore, teachers described the software as complicated to use and "little intuitive" (Annex 8.1.1). As a result, teachers experienced frustration while programming. As expressed by Teacher 3, "each simple element involved hours of work. To carry out an action, you need to go to two or three places (…). Even to take apart an element from the game, it's necessary to go back to previous paths, and if you forget a detail, you generate a problem" (Annex 8.1.1). In addition, teachers encountered difficulties in using some of the editor's functionalities. Consequently, they often asked for support in order to solve the problems they encountered with the software. Furthermore, the software functionalities did not support the realization of some of their ideas. Thus, in many occasions, they had to re-think and adapt their ideas. Teachers argued that the editor's functionalities should be improved in order to enhance the work of the designer:

- *Supporting the design of 3D environments:* teachers would have liked to be able to design a 3D game;
- *Supporting the design of rich interactions:* the interactions between players and the game environment are described as "poor, plane and not user-friendly". As Teacher 3 puts it, "I

would have liked the final product to be much more real and interactive, and give the player the possibility to feel much more immersed" (Annex 8.1.1);

- *Providing basic functionalities:* teachers stated that the editor missed basic functions. For example, it only provides two types of fonts, which limited variety inside the game.

As expressed by Teacher 3, "it is a lot of efforts to think the game, to draw characters, and afterwards, the editor did not provide the sufficient potential" (Annex 8.1.1).

Generally, the response generation stage was influenced by teachers' intra-individual elements. Regarding creativity-relevant processes, teachers' discourse highlighted a conductive work style. Indeed, they described themselves as "perfectionist" (Annex 8.1.1), and underlined their orientation towards working hard and overcoming obstacles. They worked during prolonged periods, and invested a high amount of effort and persistence in order to achieve the task. Furthermore, teachers' openness to risks appeared to be determinant, as they did not mind engaging in challenging tasks to reach their objective. Regarding intrinsic motivation, several indicators of flow appeared in teachers' discourse, i.e. concentration and loss of consciousness. In the words of Teacher 1, "we were connected all day long. There were some problems with our families, because, communication by phone was constant. Up to a certain point, [Teacher 2] and I thought: 'we have to slow down'"; "we were teaching a class and, all of a sudden, she told me: 'meeting!' and I: 'I can't I have a class', and her: 'just 15 minutes'. It became very much absorbing" (Annex 8.1.1). Furthermore, teachers were extremely engaged in the design process, and showed a high level of emotional involvement with their project. As mentioned by Teacher 1, "I will always remember Alicia. I will not remember all the projects I did, but Alicia, yes" (Annex 8.1.1). They also stated that they enjoyed the experience: "we had a lot of fun, we worked a lot (…), it was a very pleasant experience"; "I had fun and I learnt. And it is not always I have fun while I'm learning" (Annex 8.1.1). Hence, teachers argued that the design process was rewarding per se, which made it an autotelic experience.

In addition, teachers' environment played an important role at response generation. Their educational centre acted a key factor for the achievement of the game design activities related to this stage. The flexibility of their colleagues and managers acted as a positive factor. Indeed, Teacher 1 had to use some of her classes to work on the game with her students: "theoretically, I shouldn't use them for that" (Annex 8.1.3). Furthermore, the equipment available in the centre was considered as a success factor for the design process. Teachers had the sufficient resources to successfully carry out the game design activities (e.g. to test the game on digital blackboards). As expressed by Teacher 1, "to other people, this is a problem. We have a room called the audio-visual classroom. If I want to show the scene that I just created, I can use the big screen to see how it looks. So I think we're lucky" (Annex 8.1.3). Finally, students, colleagues and external institutions participated in the elaboration of contents and production of resources. In the words of Teacher 1, "our surrounding world had to get involved, there were no other options"; "from administrations, to colleagues and students, I think we reached all levels (…). And the strange point is that it wasn't planned at all" (Annex 8.1.1). This opportunity enabled them to integrate the perspectives of different actors from the educational community into their teaching practices.

d) Stage 4: response validation (2RV)

Through an iterative process, teachers evaluated and adapted the different aspects of their game, i.e. learning content, level of difficulty, interaction modes, and interface. In the words of Teacher 3, "there were moments of changes and improvements, as the content was evolving" (Annex 8.1.1). Creativity-relevant processes played an important role at this stage. Indeed, teachers' showed a high tolerance for ambiguity, as they did not mind adjusting their ideas through various cycles of adaptations and changes.

Response validation criteria (3RVC)

Data showed that teachers adapted their ideas according to different criteria. First, they looked at the veracity of the game content. Indeed, all along the design process, they refined their knowledge about the subject, and adapted the game content accordingly. Hence, teachers' factual knowledge about the domain determined the evaluation of the game elements.

Second, teachers constantly evaluated the game elements against the profile of the group of students. Indeed, they often reviewed the content according to their students' level of knowledge (Annex 8.1.1).

Third, teachers often had to simplify some of their ideas for feasibility constraints. For example, they had to keep the game mechanics basics and linear, although they had many ideas for integrating complex and non-linear dynamics. As a result, the game consists in a series of questions-answers, although they wanted to "add adventure elements into the game (…), put variables, and according to the answer, go through a path or another" (Annex 8.1.1). Furthermore, some of the scenes written in the storyboard have not been produced: "there are still ideas in the oven" (Annex 8.1.1). It is possible to identify two types of feasibility constraints because of which teachers had to simplify or discard their initial ideas. First, they frequently mentioned time as a main limitation (Annex 8.1.1):

> Teacher 1: We wanted to include more scenes. We wanted to put Pablo Picasso, because he has been in the city, but…
> Researcher: But?
> Teacher 1: But, time!

Second, teachers simplified their ideas as they discovered the editor's functionalities. As an example, the storyboard (Annex 8.1.7) stated that the game protagonist would have a bag in which she would put the objects she would find on her quest. This idea was dismissed, as it was too complicated to concretize. Furthermore, teachers stressed that they wanted to include intermediate scenes with videos. However, they had to give up this idea, as it represented "too many complications and problems" (Annex 8.1.1).

Response validation strategies (3RVS)

Teachers employed the following strategies to evaluate and adjust the elements of the game:

- *Self-testing:* they tested the different response possibilities with the game editor, and determined whether they were feasible or not. As illustrated by Teacher 2, "my main idea to change the type of font as the girl switched time periods, only this. When you are in the age of the fort, the type of font would change. Impossible".

- *Peer review:* teachers often asked for the opinion of their colleagues in order to evaluate the game content and interaction modes. They often worked on the game in the teachers' room, and informally received feedback from the teachers around them: "we worked voice aloud, surrounded by colleagues. So in a natural way, a lot of people got involved. Our colleagues gave their opinion, valued, asked us about the content and convinced us to change elements" (Annex 8.1.1). As Teacher 2 puts it, "our colleagues from the centre helped us a lot too. Besides of helping with technical aspects, they asked us questions on the game, and helped us to search for information. It has been a very nice project because we collaborated a lot" (Annex 8.1.1). Hence, colleagues served as mirrors to test and evaluate the game. In addition, teachers received comments on their project from the CEIP Ponte dos Brozos teachers, who also created their own LG.
- *Online support:* teachers frequently asked for support to the researcher in order to evaluate the feasibility of their ideas regarding various aspects, i.e. the GBL scenario, the interaction modes, usability, and the pedagogical evaluation of students (Annex 8.1.7).
- *Play-testing with students:* teachers involved students in order to evaluate the adequacy of their games for the targeted audience, i.e. they provided insights on the game content, the level of difficulty, and interaction design. To do so, teachers organized informal play-testing sessions with students, in which they had the opportunity to play the scenes, see the characters, and comment on the game (Annex 8.1.1).

e) Stage 5: outcome (2OUT)

Here I focus on teachers' perceptions on the result of the game design process (i.e. their general satisfaction with the outcome), and the way they diffused their LG among the community.

Outcome evaluation (3OE)

The design process was a challenging experience for teachers. Indeed, when the task was presented to them, they had no experience or knowledge regarding games in general, and specifically LGs. As stated by Teacher 1, "when they told me about the idea of creating a game, and showed me the ones that existed, I thought: 'this, I will not do it'" (Annex 8.1.3). As teachers dedicated a high amount of efforts and time to their project, their level of self-satisfaction is important, and they were emotionally involved with their LG. As mentioned by Teacher 1, "I call it our daughter, our jewellery" (Annex 8.1.1).

In addition, teachers were generally satisfied with the result they achieved, which they described as "better than what they expected" (Annex 8.1.1). They considered having reached their objective (Annex 8.1.4). Nevertheless, at the end of the design process, they still aimed to improve some elements of their game in order to consider it final. As mentioned by Teacher 2, "the idea was big, so we decided to cut it so to finalize and provide it on time, but knowing that we would continue it" (Annex 8.1.1).

Teachers outlined that some aspects could be improved in their game (Annex 8.1.1), such as the interaction system (they would like the player to have more choices and control on their actions), game mechanics (they would like the dynamics to be more complex and less lineal), and the completeness of contents (they would like to include more scenes, characters and elements of history).

Communication (3COMM)

Teachers argued that their game is useful for their teaching contexts and objectives (this will be widely discussed within the next sections). Furthermore, they considered that it is suitable for further educational contexts, and for different profiles of learners: "everyone can learn something from the game, be curious and attracted to it" (Annex 8.1.4). Hence, besides of using the game within their teaching contexts, teachers widely diffused it outside of their centre. As an example, it will be used in different educational contexts, such as museums (the Casa-Museo Emilia Pardo Bazán, which helped in the creation of contents, will organize activities around the games in literature events) and training centres (CEFORE, the Centre of Training and Resources of A Coruña, will publish an article in their magazine). In the words of Teacher 2, "now we want to finalize the game to share it with the community, so people who helped can enjoy it" (Annex 8.1.1). Furthermore, the city council will diffuse it to different educational channels. As voiced by Teacher 1, "many people are waiting for it" (Annex 8.1.1). Finally, teachers presented their LG for the Telefónica Foundation Educared educational innovation award[68], a Spanish national competition, and won the first price.

Finally, after the design process ended, the city council offered funding to teachers to adapt the game so to diffuse it widely in the educational centres of the city, so they are currently working on a new version.

Consequently, teachers could see that their work was recognized among the educational community. In the words of Teacher 1, "it's important to see that the game did not stay in the classroom" (Annex 8.1.3).

This experience enabled teachers to discover an innovative and valid methodology. As a result, it opened them the door to new ideas for ICT-based educational projects. As expressed by Teacher 1, "we are now starting new projects (…). I wouldn't like to work without those new possibilities. It would be difficult to go back to the old methodologies"; "I think I am changing, my way of working is changing" (Annex 8.1.3). After this experience, they do not longer want to limit themselves "to put exams and correct them" (Annex 8.1.3).

1.1.2. Collaborative game design (1CGD)

This section describes the collaboration among the team members during game design. It explores the composition of the group, as well as the collaboration processes at stake.

a) Group members (2GM)

During a brainstorming conducted among teachers who wanted to create their LGs, the members of the group decided to work together.

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[68] http://premioeducacion.fundaciontelefonica.com/

Group history (3GH)

The different members of the team had collaborated in the past, but only within sporadic activities. The decision to work together was made as teachers realized that they had similar interests.

Members' profiles (3MP)

The group was characterized by diversity. Indeed, as mentioned earlier, teachers' profiles and skills were different and complementary. Each member had a different domain of expertise useful for the achievement of the LG: Teacher 1 was expert in the domain of the game, as it focused on her discipline: "I had the pedagogical, curricular knowledge, I knew where to search for information". Teacher 3 had a high level of digital skills in comparison to the two others, as reported by Teacher 1: "there was a huge gap: [Teacher 3] was like a student in his last year, although [Teacher 2] and I were much behind" (Annex 8.1.1). Finally, Teacher 2 was considered as the creative person by the other members of the group. Besides their different backgrounds and skills, teachers stated that their ways of working were opposite: "[Teacher 2] was very perfectionist for the aesthetic aspect, and [Teacher 3] in the aspect of investigation" (Annex 8.1.1). To teachers, this diversity within the group enriched the collaboration process: "what most surprised me is that competences and needs have been setting up in the right place (…). Quickly, someone would tell: 'I do this better than you'. And the other would answer: 'yes, you do it better, you will take care of it'" (Annex 8.1.1). In spite of their differences, teachers shared a common objective for the game, and had the same vision of what they wanted to achieve (Annex 8.1.1).

b) Group processes (2GP)

Legislation (3LEG)

The distribution of roles among members was done in a spontaneous and informal manner, without pre-established rules. It was done according to each member's skills and profile, each teacher bringing their competences and personal qualities: "if it worked, it was not because we organized it. I think that each of us knew quite early where to position" (Annex 8.1.1). For example, Teacher 3 took care of the programming part. The other members did not take part in this aspect, as the functionalities of the editor were too long to learn.

Nevertheless, teachers did not always perform tasks which were in line with their skills. Indeed, Teachers 2 and 3, although not experts in the discipline taught through the game, got very interested in the topic, and actively participated in the creation of content. As expressed by Teacher 1: "[Teacher 2] also searched for information (…). I realised that he had a lot of knowledge about the city"; "[Teacher 3] has a capacity to… Well she is an economist, and however she is able to get passionate for history, arts, mythology" (Annex 8.1.1).

Hence, the distribution of tasks was characterized by spontaneity and flexibility. In the words of Teacher 2, "this flexibility worked very well" (Annex 8.1.1), and was considered as a success factor in the design process.

Distribution of tasks (3DT)

Work was considered to be equally distributed among the different group members. As stated by Teacher 1, “we worked a lot, a lot, a lot, and equally. I never felt that I worked more. You know what happened, in some cases, the workload would be higher for me this month. But suddenly, dialogs, questions, answers, investigation were ready, and you [pointing at Teacher 3] had to put it in the platform” (Annex 8.1.1).

Leadership (3LEAD)

According to teachers, leadership was centralized to Teacher 3. It was not formally decided; rather, it happened in a spontaneous and natural way, as his technical expertise provided him with the best criteria to make many decisions and organize the work methodology. For example, he selected the ICT application which was used among teachers to communicate. However, teachers asserted that the decision processes were distributed among the members of the group through regular meetings. As Teacher 3 puts it, “all decisions were fruits of a consensus” (Annex 8.1.4). Furthermore, Teacher 1 asserted: “I think the person who pushes, but does not oblige, but pushes, pushes, pushes, is him” (Annex 8.1.1).

Members communication (3MC)

The members of the group were in constant communication during the whole design process, in a face-to-face modality (at the school or during their free time), by phone, or virtually, mainly synchronously. Furthermore, communication was informal and spontaneous. As mentioned by Teacher 1, “there were no hours, you had to be on-call 24 hours a day” (Annex 8.1.1). This intensive communication was considered to be essential for an effective collaboration and for the synchronization of tasks: “each of us worked in an autonomous way, but if one of us advanced and didn’t inform the others, they couldn’t continue” (Annex 8.1.1).

Members relationships (3MR)

Many elements in teachers’ discourse highlighted good and trustful relationships, such as laughs, jokes and positives references to the team. As mentioned by teachers, “we had a lot of fun, we worked a lot, we were a lot together, and it was really pleasant” (Annex 8.1.1). A group synergy was evident, which was described as an “umbilical cord” (Annex 8.1.1).

c) Advantages of collaborative game design (2ACD)

Teachers identified the following advantages of working as a group during the game design process:

- *Lightening of the tasks:* as stated earlier, the achievement of the game involved a big amount of efforts, which teachers would not have been able to assume if they had been working in an individual manner (Annex 8.1.1).
- *Learning from others:* teachers had the opportunity to share skills and knowledge from different disciplines. As mentioned by Teacher 1, “[Teacher 2] and I now know how to use more tools” (Annex 8.1.1).

- *Learning how to work together:* for the first time, teachers had the opportunity to work as a team, and stated that they developed their flexibility. In their words, it was "an experience we never had before" (Annex 8.1.1).

- *Consolidation of a long-term collaboration:* according to teachers, the project enabled them to effectively work as a team: "a team was born from this collaboration" (Annex 8.1.1). From this experience, they jointly engaged in new ICT-based educational projects, such as a wiki-based learning activity, and another one related to augmented reality: "we have transformed into a kind of permanent team"; "we thought that, as we work so well together, we had to continue" (Annex 8.1.1).

d) Challenges of collaborative game design (2CCGD)

In contrast, teachers outlined the following challenges in collaborative work:

- *Long decision processes:* teachers outlined that the group work sometimes involved ineffective sessions. As mentioned by Teacher 1, "I always had the feeling that we had been talking and talking, but that nothing had been done" (Annex 8.1.1).
- *Difficulty to adapt to others:* they sometimes found it difficult to adapt to each other's rhythms and ways of working. Hence, they had to adapt to each other's: "I thought that my way of working was the best one, and I discovered that it was not the case" (Annex 8.1.1).

1.2. Product dimension

This section examines creativity according to the product dimension. It looks at the LG and the GBL scenario created by teachers from Case 1 (Annexes 4.1.1 and 4.1.2). As mentioned earlier, I explored this dimension through two criteria, i.e. usefulness and novelty. The usefulness of the LG is reflected in three different aspects, i.e. gaming aspects (its ability to provide a fun and engaging experience to targeted students), pedagogical aspects (its potential to fulfil the planned pedagogical objectives and to provide a rich learning experience), and usability (the functionality of the user interface and its potential to provide a pleasant experience). The novelty criterion was examined regarding little-c (teachers themselves), middle-c (students and the educational centre), and Big-C (the market) creativity. Analysis was performed on the basis of data collected with interviews with two experts in the field of GBL (Annexes 8.1.2a and b) and with Teacher 1 (Annex 8.1.3).

Furthermore, in order to corroborate findings, a questionnaire was used with 13 students after they played the LG *Alice's Trip*. The different factors explored in the questionnaire enabled to collect students' experience regarding the following aspects of the product dimension: balance of difficulty (through the challenge factor in the questionnaire), clarity of goals (through the goal clarity factor), clarity and constancy of feedback (through the feedback factor), easiness of use (through the autonomy factor), and immersion (through the immersion factor). The results of the questionnaire are available in Annex 8.1.5. Table 18 and Figure 26 illustrate the results of the questionnaire per factor.

FACTORS	MEAN	SD	MEDIAN	MODE	VARIANCE	MINIMAL	MAXIMAL
Goal clarity	4,58	0,64	5,00	5,00	0,41	3,00	5,00
Challenge	3,62	1,00	3,67	2,33	1,00	2,33	5,00
Feedback	4,15	0,59	4,00	4,00	0,34	3,00	5,00
Immersion	3,41	0,70	3,50	3,67	0,49	2,33	4,67
Autonomy	4,69	0,52	5,00	5,00	0,27	3,50	5,00
Innovation	3,08	0,93	3,00	4,00	0,87	1,50	4,50

Table 18: Results of students' questionnaires per factor (product dimension) - Case 1 (*n* = 13)

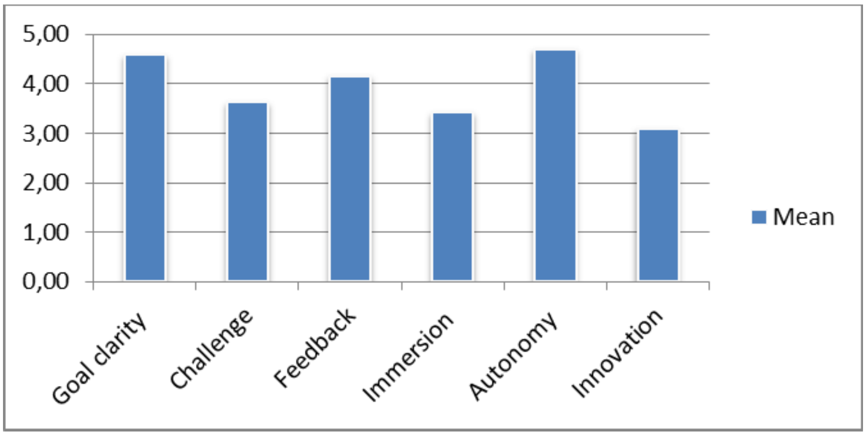

Figure 26: Results of students' questionnaires - Means per factor (product dimension) - Case 1 (*n*=13)

1.2.1. Usefulness (1USE)

a) Gaming aspects (2GA)

Clarity of pedagogical objectives (3CPO)

Both the teacher and the experts considered that the objectives of the game are clearly defined. Expert 2 argued that the goals of the game are clear, "even without reading" (Annex 8.1.2b). In addition, the goal clarity factor scored very high in students' questionnaire results (M = 4.58, SD = 0.64). Students strongly agreed that they clearly understood the game objectives (M = 4.62, SD = 0.77), and that they knew what they had to do and reach while they were playing (M = 4.54, SD = 0.66). The observation also showed that students understood, in an autonomous manner, what they had to do in the game.

Nevertheless, Expert 1 stated that it would be suitable to add, in some scenes, some reminders of the final objective, in order to guide players and enhance their motivation (Annex 8.1.2a). Indeed, objectives are only presented once, i.e. in the initial book of instructions which appears at the beginning of the game, and which contains many other types of information.

Balance of difficulty (3DIFF)

According to the teacher, there exists a lack of balance in the game. Indeed, she considered some scenes to be too easy, and some others too difficult. She mentioned that her and her colleagues aimed to add progression within the game, by making the second part more difficult. However, to her, the result created a gap in the balance of game.

In contrast, Expert 1 considered the balance of difficulty adequate, although he stated that he was not familiar with the level of students. However, he did not perceive any progression of difficulty: “I have the feeling that all questions are of the same level of difficulty” (Annex 8.1.2a). He described the game too “lineal” and “repetitive” (Annex 8.1.2a). Indeed, all the scenes work on the same model, i.e. one question and three possible answers. In his words, “the following scenes do not involve learning regarding the way of working of the game”, and “the player is never in a situation of not knowing what to do” (Annex 8.1.2a). To him, repetition represents the weakest aspect of the game.

In addition, the second expert argued that the difficulty is not personalized, as there is no possibility to adapt it according to students’ level of skills. However, she recognized it would be a lot of effort of programing, which may not worth it. Furthermore, she considered that the game lacks challenge and difficulty. In her words, “games of questions and answers have little of games. In *Trivial Pursuit*, there are questions, but it’s a game, because it has the little pieces of cheese, you can choose your way, questions might be more difficult, until reaching the limit of your knowledge” (Annex 8.1.2b). Hence, she suggested adding more game elements, such as rewards and risks, in order to stimulate the student to not fail: “if you fail three times, I don’t know, something could happen to the poor Alice!” (Annex 8.1.2b). In her words: “I think this is a problem of creativity of teachers, when you ask them for a game, everything is reduced to questions and answers (…). To me, this is a fun exam, more than a game” (Annex 8.1.2b).

Finally, results of the questionnaire showed that students tend to positively value the challenge of the LG (M = 3.62, SD = 1.00). Students agreed that the game was challenging, but that they were able to solve it (M = 3.54, SD = 1.20). They also agreed that the game was neither too easy nor too difficult (M = 4.08, SD = 1.12). Finally, students’ opinion was not clear regarding the potential of the game to provide them help in case of difficulty (M = 3.23, SD = 1.59).

Clarity and constancy of feedback (3FEED)

The teacher argued that her and her colleagues carefully integrated feedback elements for all the actions carried out by the player. However, she recognized that this aspect is treated in a “primitive way: correct answer, ‘I pass’, question-answer, ‘I repeat’” (Annex 8.1.3). She explained that her team did not have sufficient technical skills to elaborate more sophisticated feedback loops.

Expert 1 confirmed these statements, by asserting that feedback is constant, clear, but too simple to promote players’ immersion. Furthermore, Expert 2 suggested adding more feedback elements (i.e. reinforcements) to make the game more playful, such as a constant visible score indicating the number of right and wrong answers, and the possibility to gain status (e.g. from “junior” to “senior”). He stated that players should receive more information regarding their performance, “which could be a badge, or a number, so I can know whether I am gold or silver” (Annex 8.1.2a).

The feedback factor scored high (M = 4.15, SD = 0.59). Students strongly agreed that they received the necessary feedback on their actions (M = 4.31, SD = 0.59), and that the game correctly informed them on their success or failure (M = 4.69, SD = 0.85). Nevertheless, in accordance with the opinion of Expert 2, their opinions were not clear regarding the item “the game was informing me of my progress” (M = 3.46, SD = 1.27).

Clarity and consistence of rules (3RULES)

Both the teacher and the experts considered rules to be clear and consistent all along the game. Indeed, they are explained at the beginning of the game, and do not change along the process. As expressed by Expert 2: “the only rule is that you cannot leave the scenes until you correctly answer to the questions” (Annex 8.1.2b).

Immersion (3IMMER)

To the teacher, the game narrative was interesting for students: “they immediately saw the relation to the novel of *Alice's Adventures in Wonderland*, and they liked it” (Annex 8.1.3). Furthermore, she argued that the time travel narrative was appealing to students, and that the topic (i.e. the history and mythology of A Coruña city) surprised them, as they are familiar with it given their cultural context.

Nevertheless, the teacher believed that the graphical environment was “flat” for students (Annex 8.1.3). She explained that the mobility of characters is limited, and that students sometimes criticized this aspect: “look, the character is walking in the air” (Annex 8.1.3). However, in the teacher’s words, “they know it’s done by their teacher, so they look at it amazed” (Annex 8.1.3).

She also described the structure of the game as repetitive, i.e. question, answer and conversation with characters. Indeed, Teacher 3 stated that their intention was to “add variables according to the type of answer, go to one path or to another” (Annex 8.1.1). In the words of Teacher 1, “we wanted to add more adventure in the game, and to play with content, without questions, but it has been impossible. We repeated the same scheme, so there is a lot of content, and little of game” (Annex 8.1.3).

Expert 1 agreed on this last point. To him, the game cannot enhance students’ immersion. Indeed, he highlighted a gap between the LG designed by teachers, which he considers “amateur”, and the commercial games that students are used to play, whose level of complexity, audio-visual language, and playability are high. In the expert words, “this gap cancels the capacity of immersion” of the game (Annex 8.1.2a). To him, “the level of distance is too high” (Annex 8.1.2a). Furthermore, he argued that scenes should include more elements which provide fun and engagement.

Furthermore, he mentioned that aesthetics are not adequate to students’ age range. Expert 2 agrees on this point: “I see a precious story, full of content, for students from compulsory secondary education. For this age, I think that the elements would enhance immersion. For 16-18 years, I cannot imagine that they will be elements of immersion” (Annex 8.1.2b).

In contrast, Expert 2 asserted that the game characters enable students to understand the cultural diversity related to the different periods addressed in the game: “the king, Emilio Pardo, many characters appear, their clothes, the change of period. Not often you have the opportunity to see everything in the same sequence, see how the haircut and the way of clothing change” (Annex 8.1.2b).

Students' opinions on immersion were unclear (*M* = 3.41, *SD* = 0.70). Students agreed that time passed quickly as they were playing the game (*M* = 4.31, *SD* = 0.63), which demonstrates that they generally experienced a transformation of time. Nevertheless, their opinions was not clear regarding their capacity of forgetting about their surroundings (*M* = 2.62, *SD* = 1.19). Students agreed that they enjoyed playing and would like to play more (*M* = 3.54, *SD* = 1.20). However, their opinions were not clear regarding their involvement with the game (*M* = 3.00, *SD* = 1.15). Finally, they agreed that they did not care about wining, as they were having a great time by only playing (*M* = 3.77, *SD* = 0.83).

b) Pedagogical aspects (2PA)

Clarity of pedagogical objectives (3CPO)

To Expert 1, the educational objectives are clearly stated in the GBL scenario, and are accordingly reflected in the game. Nevertheless, Expert 2 argued that some of the transversal objectives stated in the scenario (e.g. respect for cultural diversity and for the environment) are too ambitious, as they create high expectations, but are not correctly solved in the game. While referring to the GBL scenario, she argued: "when I read this, I imagine something much more powerful" (Annex 8.1.2b).

Connection to the curriculum (3CURRI)

To the teacher, the game perfectly matches her curriculum objectives. In her words, "I think that contents are very adequate to what students will be asked in the final exam" (Annex 8.1.3). Furthermore, the game connects to various disciplines of the humanities and social sciences branch, such as classical languages, art history, and history. As expressed by the teacher:

> All of a sudden, in one hour of playing, in one only package, I can combine topics, contents, even disciplines, which normally don't match together. It is very good that students are able to see, at the same time, the toponymy of a place, the history of this place, the way it looks today and the way it looked in the past. This, with a textbook, or with a usual ICT-based material, is impossible to combine. But the game allows it (Annex 8.1.3).

Furthermore, Expert 1 recognized that many elements of the game are related to the disciplines planned in the GBL scenario, and Expert 2 positively values the curricular aspects addressed in the game.

Alignment of game play and pedagogical objectives (3ALIGN)

According to Expert 1, the pedagogical objectives are effectively contextualized in relation to what the player has to achieve in the game, i.e. to correctly answer questions in order to complete the story. Thus, they are well linked to the game objectives. In contrast, Expert 2 argues that some of the transversal pedagogical objectives planned in the GBL scenario are not reflected in the game.

Appropriateness to the profile of students (3APPRO)

The teacher stressed that the pedagogical objectives are completely adapted to her group of students. Indeed, she mentioned that, while her and her colleagues designed the game, they gave a lot of importance to this aspect: the game content was tested in informal manners, by assessing students' previous knowledge and verifying whether they would learn through the game (i.e. the teacher asked her students what they knew about the topic and measured their level of knowledge).

Although Expert 1 is not familiar with students' profile and level of knowledge, he argued that the game content could be more complex, and include more elements of knowledge, in order to match students' age range. Expert 2 also argued that the level of the pedagogical objectives should be higher.

Planning of complementary activities (3ACTI)

To the teacher, the game is well integrated in the context of other educational activities that are described in the scenario, i.e. introduction of the topics in the classroom and visit of the sites described in the game. To her, playing the game with students makes it easier to "take them out of the classroom and enjoy the visit" (Annex 8.1.3). However, she mentioned that, after the first experience with the game, she would adapt the order of the activities so to make them more meaningful: "for the next course, I aim to give contents in the classroom and explain them. Then, I would conduct the activities in the city, the sites, museums. Finally, they would play the game, which would serve as an evaluation" (Annex 8.1.3).

To Expert 1, the proposed activities, in particular the visits to the sites planned in the GBL scenario, can interest students: "this is when they face the richness of knowledge" (Annex 8.1.2a). In this context, "the game per se consolidates knowledge", and constitutes a "support" (Annex 8.1.3). Expert 2, however, argued that the activities proposed in the scenario should be more bounded together.

Pedagogical evaluation (3EVAL)

The GBL scenario states that students' pedagogical evaluation would be performed through the game, i.e. by looking at the number of correct answers, mistakes, and the number of times students consulted the books. The teacher plans to proceed this way for the next course: "once the topics have been introduced, and then strengthened through the field visits, I would like them to play, to so evaluate them" (Annex 8.1.3). Nevertheless, she could not proceed in this manner this time: "the first time, it was not so ordered, maybe because the elaboration of the game occupied a lot of our time" (Annex 8.1.3). Hence, she conducted exams in order to evaluate students' knowledge, as the game had been used earlier in the process.

To Expert 1, knowledge can be easily evaluated through the game itself: "players are informed that they have to take on a challenge, and a score enables to measure their performance" (Annex 8.1.2a). Nevertheless, he stated that players are not correctly informed of their progression along the game.

Adequate use of documentation resources (3DOCU)

To both experts, the game provides players with valuable content related to the pedagogical objectives. However, Expert 2 stated that the game does not ensure that students will consult it. Indeed, as mentioned by Expert 1, content is presented massively, at the same time, in a lineal way, which can discourage students to pay attention to it. Furthermore, he argued that the game could provide links to other sources, like Wikipedia, so that students have to search for the right information themselves. Indeed, "at this age, students should be able to search for information", and "what teachers should avoid is to provide them with the information directly, as it is done in the game" (Annex 8.1.2a). Teachers' intention was to include external links to resources in their game, but argued that the eAdventure editor did not allow it.

Planning of necessary resources (3RES)

Both the experts and the teacher stated that resources were planned in an effective manner, so that the educational activity could be conducted adequately in the classroom. Indeed, Spanish schools are generally well equipped with regards to technology, and running the game does not require any particular material. In the words of Expert 2: "It's even a game you could play at home. Easily. You can review your lesson in a nicer and funnier way" (Annex 8.1.2b). Furthermore, Expert 1 noted that the GBL scenario effectively takes into consideration the necessary resources, i.e. time, ICT resources, etc.

Attention to diversity (3DIV)

According to Expert 1, the game addresses the specific socio-characteristics of students, as it includes topics related to their city and regions. Furthermore, he outlined the effort made by teachers of providing the game available in both Spanish and Galician languages. Expert 2 positively valued the fact that both genders are represented in the game, and that the main character is a girl. Nevertheless, she argued that Alice's character looks more like a teacher than a student.

c) Usability aspects (2UA)

Easiness of use (3EAS)

The teacher mentioned that students did not meet any significant difficulty when using the game. Furthermore, experts considered the functionalities easy to use, to learn and to remember. They were both confused at the beginning of the game, when trying to find which elements were interactive, and then quickly understood the interaction system. Expert 1 stated that everything is well explained in the instructions provided at the beginning of the game. In his words, "first, it can be a bit challenging, but when you learn it, and you follow the instructions, I don't think it is complicated".

Questionnaire results show that students did not meet any major difficulty regarding usability, as the autonomy factor scored very high (M = 4.69, SD = 0.52). Students strongly agreed that it was easy to manage the game (M = 4.62, SD = 0.65) and to learn how to use it (M = 4.77, SD = 0.44).

Minimizing of errors and dead points (3ERR)

The only negative aspect regarding usability is the presence of some dead points. Indeed, experts found some errors while playing the game. For example, the game does not indicate to players which characters are interactive and which are not. Hence, players have to test, by trial and error, whether they can speak or not to a character.

Easiness of installation (3INSTAL)

The teacher and the experts considered that the game is very easy and fast to install, and does not require any complicated operation or material. Furthermore, they positively valued the fact that the game is available online.

Compatibility (3COMPA)

All respondents argued that the compatibility aspect is correctly addressed. Nevertheless, Expert 1 mentioned that the game should also be available for mobile, and thus recommended using HTML5 as programming language.

Accessibility (3ACCES)

To Expert 1, accessibility aspects are not addressed in the LG. Indeed, the game does not allow for the adaptation of the interface according to players' special needs. He mentioned that, "to create an accessible game, it's necessary to take into account many variables and aspects, it's complicated" (Annex 8.1.2a).

In contrast, Expert 2 argued that the game could be easily used by a wide profile of students, including younger children: "there is not a lot to read, the letters in the book are very clear. The majority of children, even younger ones, can use it without problems. They only need a mouse, and it's easy" (Annex 8.1.2b).

1.2.2. Novelty (1NOV)

a) Little-c creativity (2LCC)

Teachers (3TEACH)

The teacher stated that the LG is innovative in comparison to the resources she usually uses. She considered the game to be "much more visual than textbooks or platforms like Moodle" (Annex 8.1.3). Indeed, "in Moodle, only the packaging changes, but content is composed of exercises, the dynamics are not related to characters, you don't listen to anything" (Annex 8.1.3). Furthermore, she never built a resource which includes drawings, self-made resources (e.g. photographs, students' and colleagues' voices), and interactive elements.

b) Middle-c creativity (2MCC)

Students (3STU)

To the teacher, the game is innovative in comparison to the learning resources habitually used by students: "the innovation implied by seeing contents this way; it called their attention" (Annex 8.1.3). However, she did not consider the game to be innovative with regards to the digital games used by students. Indeed, "they are used to this type of platforms and to digital games", and "they have a huge culture on games" (Annex 8.1.3). Expert 1 confirmed this last statement: "students already know well digital games. For them it is not innovative. On the contrary, it is somehow archaic" (Annex 8.1.2a).

Finally, students' opinions regarding the innovative character of the gaming activity was not clear (M = 3.08, SD = 0.93). They partially agreed on saying that this form of learning was innovative (M = 2.92, SD = 1.44), and that they were not used to conduct this type of activity in the school (M = 3.23, SD = 1.30).

Educational centre (3EC)

Regarding the educational centre, the teacher argued that the game represents an innovative methodology in her institution: “I think it’s the first time that such resources are being used”. Furthermore, in her words, “the game is innovative in the school, because us, teachers, are far away from using this type of tools in a regular way” (Annex 8.1.3).

c) Big-C creativity (2BCC)

Existing learning resources (3ELR)

The teacher did not consider the game innovative in relation to other existent resources available in the market. For example, she mentioned that there already exists a LG related to the Tower of Hercules directed to primary school students. Nevertheless, she considered the game to be original in relation to some other LGs which do not include such a density of information: “regarding this aspect, yes, it’s innovative, for this type of students, with this level of difficulty, I don’t think there exists other things” (Annex 8.1.3). Expert 1 considered the game to be behind some educational resources which are available in the market, such as mobile applications to learn Algebra.

Existing games (3EG)

In comparison to digital games available in the market, the teacher stressed that “students think that it is not innovative (…). But students have very high requirements, and very few things can surprise them” (Annex 8.1.3). Furthermore, to experts, the game is absolutely not innovative regarding the games which exist on the market. As expressed by Expert 2, “this game, if it had been designed by students, would be innovative, if students had searched for information and designed this game for their schoolmates. The work that teachers did, of searching and integrating information, students from secondary levels could have done it” (Annex 8.1.2b).

1.3. Teaching dimension

This section analyses the application of the LG *Alice’s Trip* in the classroom. It looks at both teachers’ (the way they organized the GBL activities and their role during the game session) and students’ (their level of engagement and achievement of the pedagogical objectives) perspectives. The analysis mainly relies on data collected through the interview with Teacher 1 (Annex 8.1.3). In addition, it takes into account students’ questionnaire results (Annex 8.1.5), and the classroom observation report (Annex 8.1.6).

1.3.1. Teachers’ experience (1TE)

a) Organization of the GBL activities (2ORG)

The strategies employed by the teacher to organize the GBL activity have been different from the ones planned in the GBL scenario. Indeed, the scenario (Annex 4.1.2) first planned that students would learn about the topics addressed in the game, by viewing some videos and visiting the sites and museums presented in the game. Afterwards, it was planned that they would play the game, which would serve as a tool to evaluate students’ knowledge. The activity would be completed with an assessment of the activity, including a debate about the difficulties encountered by students while playing the game. Nevertheless, the teacher could not organize activities this way, due to feasibility reasons (Annex 8.1.3). Students played the game before visiting the sites. Hence, she did not evaluate students only through the game, and organized complementary exams. She argued that she would do it "the correct way" for the next application of the game.

b) Role during the game session (2RGS)

The classroom observation (Annex 8.1.6) enabled to describe the organization of the GBL session. The teacher first explained students how to launch the game. Afterwards, she gave instructions to students: she resumed the objective of the game, i.e. to answer all the questions correctly with the least time and errors. Furthermore, she explained that they had the possibility to consult the book if they needed information, but that their final performance would be affected by this choice. She also quickly clarified the game's functionalities, i.e. how to use objects, interact with characters, and how to generate their evaluation report at the end of the activity. Each student had a laptop and played individually. The game lasted for 20 minutes approximately. During the game session, the teacher was walking through the classroom. She let students play in an autonomous manner, while remaining available for any doubt or question. Through an observer stance, she analysed students' behaviours and intervened when necessary. She mentioned that students called her for help once in order to solve technical problems, and another student asked her to clarify a question.

The teacher stated that she was very relaxed during the GBL session: "it was a very profitable class, as students were all the time working, concentrated, and focused on contents" (Annex 8.1.3). The climate of the classroom was quiet and relaxed. Thus, she enjoyed the class much more than usually, as contents was directly faced, without losing time with other things.

1.3.2. Students' experience (1SE)

Students experience while playing the LG was explored through different aspects, namely immersion, concentration, autonomy, social interactions and the achievement of the pedagogical objectives. I considered data collected through an interview with Teacher 1 (Annex 8.1.3). Furthermore, in order to corroborate findings, I looked at the results of the questionnaire (Annex 8.1.5). Table 19 and Figure 27 illustrate the results of the questionnaire per factor. Furthermore, I looked at the classroom observation report (Annex 8.1.6).

Factors	Mean	SD	Median	Mode	Variance	Minimal	Maximal
Autonomy	4,69	0,52	5,00	5,00	0,27	3,50	5,00
Concentration	3,19	0,99	3,00	3,19	0,98	1,50	5,00
Immersion	3,41	0,70	3,50	3,67	0,49	2,33	4,67
Social interactions	1,79	1,02	1,67	1,00	1,05	1,00	4,33
Knowledge improvement	4,00	0,57	4,00	4,20	0,33	2,80	4,80

Table 19: Results of students' questionnaires per factor (teaching dimension) - Case 1 (*n* = 13)

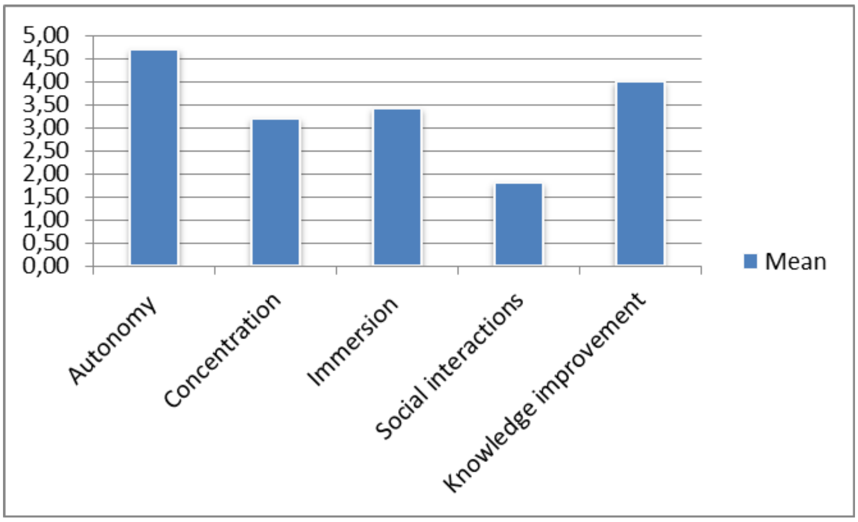

Figure 27: Results of students' questionnaires - Means per factor (teaching dimension) - Case 1 (*n*=13)

a) Engagement (2ENG)

Immersion (3IMM)

The teacher argued that most students were highly engaged and absorbed with the game. The observation highlighted some positive behaviours during the GBL session, i.e. they were generally relaxed, and many of them were smiling. Furthermore, they were surprised to discover the different elements of the game, as they had not seen the scenes and the characters before. They positively valued the narrative of the game. Nevertheless, the teacher stated she was not sure that all students had fun. To her, "it's very complicated to please them" (Annex 8.1.3). Some of them laughed at the defaults of the game (e.g. illustrations and animations), which limited their immersion in the activity.

As mentioned in Section 1.2.1, questionnaires' results showed that students' opinions regarding immersion were unclear. They agreed that time passed quickly as they were playing the game. Indeed, they probably felt that time passed quicker than during common lectures. Nevertheless, the items referring to the loss of self-consciousness scored lower: students only partially agreed that they forgot about their surrounding environment while playing. They agreed that they enjoyed playing, but their opinions were not clear regarding their involvement with the game. Finally, regarding the factor related autotelic experience, they agreed that they did not care about wining, as they were having a great time by only playing.

The three data collection sources coincide in that most of students experienced immersion while playing, in spite of some distractions caused by the defaults of the game and the classroom environment.

Concentration (3CONC)

To the teacher, students were concentrated and silent during the game session. They all were wearing headphones and focused on the game objectives. Furthermore, they all finalized the game. In her words, "I think that if I could make profit of all classes with this level of concentration, I would finish the syllabus immediately!" (Annex 8.1.3) The observation also showed that students focused on the game all along the activity. They carefully read the book of instructions, and solved the game without showing distracted behaviours. Indeed, no off-task activity or conversation was observed.

Regarded the results of questionnaires, the concentration items scored average (*M* = 3.19, *SD* = 0.99). Indeed, students only partially agreed that they were totally concentrated (*M* = 3.46, *SD* = 1.20), and that it was easy not to be distracted while playing (*M* = 2.92, *SD* = 1.38). This can be explained as the game was played in the classroom. Students were surrounded by their classmates, and the concentration was not as optimal as if the game would have been played at home.

Autonomy (3AUTO)

Both the observation and the interview with the teacher revealed that students could learn in an autonomous manner during the game session, and intuitively learnt how to manage the functionalities. They almost never asked for help, and could solve the game objective according to their own rhythm. In some cases, they asked their classmates how to carry out some actions, and could follow the game without any problem. Furthermore, all students achieved the objectives of the games without requiring any support.

Results of the questionnaire corroborated this statement. Indeed, the autonomy factor received the highest mean among all categories (*M* = 4.69, *SD* = 0.52). As stated in Section 1.2.1, students strongly agreed that the game was easy to learn and to manage the game.

Nevertheless, although teachers wanted to achieve dynamic mechanisms, the game turned to be lineal and to guide students' actions and choices, thus leaving them a little margin of freedom (Annex 8.1.3).

Social interactions (3SI)

The LG was designed to be played in an individual manner. As a result, students solved the objectives of the game by themselves. Consequently, the social interactions factor scored low (*M* = 1.79, *SD* = 1.02). Students did not agree on saying that they solved some of the game tasks with the teacher (*M* = 1.62, *SD* = 0.96) or with their classmates (*M* = 1.85, *SD* = 1.28). Furthermore, the item "I was talking to my classmates while playing" scored low (*M* = 1.92, *SD* = 1.38). This can be explained as students focused on games, instead of on interactions with students.

Nevertheless, the interview and the observation showed that students collaborated, in some cases, in order to help at each other's and to solve some usability issues. In the words of the teacher, "I perceived that they took out their headphones, and the classmate looked at the screen of the other, asked him a quick question, and the other gave him some instructions". Furthermore, "there was a moment in which I didn't need to go, because the classmate had been able to solve the problem" (Annex 8.1.3).

b) Achievement of the pedagogical objectives (2APO)

To the teacher, students could reach, by playing the game, the pedagogical objectives stated in the scenario. She even asserted that the objectives could be extended to higher grades: "the game is designed for students in their first year of upper secondary education. But I know I can use it, recycle it for 2nd years' students. I can even use it for other contents of my program, such as linguistics, history and art" (Annex 8.1.3).

In addition, some content of the game fostered discussions among students. For example, the game presents some famous Galician writers, which students had discovered in the context of other classes. The content of the game presented different sources of information. Students brought the game at home and reflected, as the information they received seemed biased. To the teacher, the game "created doubts, or expectations. They [students] searched for this novel which they read and which is in the game, for this character that they don't know" (Annex 8.1.3). As a result, students showed curiosity regarding the contents of the game, asking the teacher if they were going to visit the places and museums they had seen in the game, and if some of the books cited in the game were available in the school library. In her words, "it opened some doors" (Annex 8.1.1).

The knowledge improvement factor scored high (M = 4.00, SD = 0.57). Students agreed that they could both apply knowledge they learnt in class (M = 4.08, SD = 1.19) and acquire new elements of knowledge (M = 4.46, SD = 0.66). Furthermore, the score for the item "I understood what the game wanted to teach me" was high (M = 4.31, SD = 0.75). Finally, students agreed that the game motivated them to learn (M = 3.62, SD = 1.04), and that they want to know more about the topic taught in the game (M 3.54, SD = 0.78).

1.4. Teachers' perspectives on creative pedagogies

To teachers, creative pedagogies involve different parameters, i.e. hard work, investigation, and risk taking. As voiced by Teacher 1:

> I think that a creative teacher has to work a lot. This is fundamental. Work a lot, investigate a lot, dive a lot, and, last, reflect on how to make the most of all this in the classroom. And, above all, be daring: all this work and all this reflection, I am going to do it, and I'm going to do it good.

Furthermore, creating one's own resources appeared as key for teachers' creativity. Teachers outlined that attention should be given to the final result, rather than on the means to reach it. Indeed, to Teacher 1, it is important to "cross the line that separate teachers from the 'I'm going to create, it doesn't matter how, I will see that later. First, I work (...) and then I will jump, and we will see how it results'". The teacher argued that jumping into the water without knowing how it would result was scary. Thanks to this experience, she is not scared anymore.

2. Case study 2: design and application of the LG Tuning up a Bicycle

In this section, I analyse the design and application of the LG *Tuning up a Bicycle* (Annex 4.2.1), by the two teachers from Case 2, from the IES Sabón educational centre. As for Case 1, the analysis is structured according to the different dimensions and themes explored in the research.

2.1. Process dimension

This section explores the process through which teachers designed their LG. As for Case 1, the discussion explores the different stages of educational game design, and looks at the influences of the person and press dimensions on these stages. It also examines the collaborative processes among teachers. The discussion is based on data collected through teachers' interview (Annex 8.2.1), questionnaire (Annex 8.2.4), and game design documentation (Annex 8.2.7).

2.1.1. Game design stages (1GDS)

a) Stage 1: task identification (2TI)

Engagement in the task (3ET)

As for Case 1, teachers learnt about the research project through the Ponte dos Brozos project, when the ICT coordinator of the centre presented them the game design approach.

First of all, teachers decided to undertake the game design process, as they were willing to discover and experiment new teaching methodologies, and more specifically GBL. Indeed, they showed curiosity towards using games in the classroom. Teacher 1 was curious to "know how students would see the fact of working certain content through games, and whether they would accept it" (Annex 8.2.1). Hence, teachers wanted test this new approach. As expressed by Teacher 1, "the objective was to check whether a series of contents, which is given in a practical way in the classroom, could be applied in a game" (Annex 8.2.1).

Second, teachers perceived games as resources with "a big educational power" (Annex 3.1), which would enhance their pedagogical objectives and their students' motivation. As expressed by Teacher 1: "I needed to develop an attractive way to standardize the protocol of revision of a bicycle" (Annex 8.2.1).

Finally, teachers found the idea of designing their own LG attractive per se. Indeed, as expressed by Teacher 2, "to learn how to design a game is already attractive. And the idea of designing a game with which it is possible to learn, is very cool, no?" (Annex 8.2.1). Hence, both the design process (i.e. intrinsic motivation) and its outcome (i.e. extrinsic motivation) stimulated teachers for engaging in the task. Furthermore, regarding creativity-relevant processes, their openness to experience and interest in the domain of GBL determined their participation in the research.

Definition of the pedagogical objectives (3DPO)

Teachers decided together to design a LG which they could apply in their teaching settings. They chose the topic of the bicycle mechanics (i.e. the procedure to follow to tune up a bicycle before riding it), which is part of the curricular objectives in the discipline taught by Teacher 1, i.e. physical activities and sport in natural environments.

b) Stage 2: preparation (2PRE)

Domain-relevant skills (3DRS)

The design process required teachers to build a wide range of technical skills. Apart from the functionalities of the eAdventure editor, they learnt how to use different software programs to edit pictures and how to manage different types of files (e.g. graphical files). In contrast with Case 1, teachers did not need to acquire factual knowledge about the domain. Indeed, the educational content transmitted through the LG (i.e. the 10 steps to follow to tune up a bicycle) was clear to them from the outset, and did not evolve along the design process.

Learning process (3LP)

Although they were introduced to the eAdventure functionalities during initial training sessions, teachers mainly developed the necessary technical skills afterwards, in an autonomous manner, along the design process. As voiced by Teacher 2, "it's like for each informatics tool: it's by using it that you learn it. The thing is, when you design your first game is when you encounter all the difficulties". Furthermore, "as it is the first game we created, when we finished is when we should have started" (Annex 8.2.1). Hence, the learning process was iterative and based on problem-solving strategies.

c) Stage 3: response generation (2RG)

The next paragraphs explore the processes through which teachers generated solutions for their LG, according to three different steps, i.e. conceptualization, elaboration and production.

Conceptualization (3CONC)

As explained earlier, teachers decided to design a LG on the subject taught by Teacher 1. They wanted students to study "a series of content in a theoretical way in the classroom, then in a practical way in the workshop, and finally to surprise them by applying content in a game" (Annex 8.2.1).

The team preferred to choose an idea which was easy to develop. Indeed, teachers argued that it was their first time designing a game. Furthermore, they considered the time resources available to them, and developed their idea accordingly. In the words of Teacher 2, "we did not have a lot of time, and we thought of a simple idea in which the student would be the protagonist" (Annex 8.2.4). They also took into account the material resources at their disposal. Indeed, they decided to design a game on the basis of pictures taken in the school settings (i.e. the bicycle workshop), with resources easily accessible. As expressed by Teacher 1, they developed their idea "a bit for the easiness" (Annex 8.2.1).

Hence, teachers considered the following parameters to conceptualize their LG:

- *Curricular objectives:* they developed an idea which could effectively enhance their educational objectives.
- *Teachers' domain-relevant skills:* the idea was determined according to Teacher 1's domain of expertise.
- *Available resources:* they aimed to achieve the game autonomously, without any external help. Hence, they considered the resources at hand in order to conceptualize their game, i.e. technical (i.e. computers, a video camera, and a camera) and spatial (i.e. the bicycle workshop) resources. As mentioned by Teacher 2, "we chose to create a game using our own pictures, so be autonomous during the design process" (Annex 8.2.4); "we wanted to create a game with what we had" (Annex 8.2.1).

Teachers maintained their initial idea along the design process. Indeed, they asserted that it perfectly matched their curricular objectives: "the only thing we had to adapt was the reward, that is, the video. But the main idea was maintained" (Annex 8.2.1).

Elaboration (3ELAB)

On the basis of their idea, teachers elaborated the contents of their LG. As the pedagogical objective was clear and succinct, this process was rather fast. Indeed, teachers did not need to search for contents. They only had to prepare contents in order to make them easy to learn for students. Hence, they synthesised the procedures of tuning up a bicycle into a series of 10 different steps.

Following the suggestions given during the training workshops, teachers started to create a storyboard, in order to develop the structure of their game, as well as to start designing the characters and objects. However, they realized that their idea was clear and simple, i.e. the practice of the 10 steps required to tune up a bicycle, in two different scenes of the bicycle workshop. Hence, they quickly decided to work directly with the editor.

Production (3PROD)

Hence, very quickly, teachers engaged in the production step. As mentioned above, their idea was to do everything by themselves, "without any external support" (Annex 8.2.1). Hence, they created all the graphical elements from scratch: they took pictures in order to create the scenes and the characters, and shoot videos for the possible game endings. Furthermore, they aimed to use realistic resources, close to students' environment and reality. Hence, the protagonist is a student, and the game scenes are pictures from the bicycle workshop from the educational centre.

Afterwards, teachers edited their resources in order to improve their quality (for example, they took out the background from some pictures in order to integrate them with the other graphical elements) and to animate characters. As voiced by Teacher 1, "we spent a long time in trying to give dynamism to the pictures of the protagonist (…). We didn't want pictures to seem static; this gave us a lot of work" (Annex 8.2.1). Teachers described this process as laborious and time consuming.

The programing part was also considered to be laborious. Indeed, programming simple actions involved a high amount of time as well as an important learning process. In the words of Teacher 2, "you have to go very slow for each little step. Each little step of the game involves previous learning"

(Annex 8.2.1). Furthermore, teachers described the editor as difficult to use. As expressed by Teacher 2, “we just wanted the player to take a tool, and it was so complicated” (Annex 8.2.1). Consequently, teachers had to focus their efforts on the programming part, and could dedicate less time and effort to the other game design activities, such as the elaboration of rich game dynamics and interactions.

As for Case 1, the editor’s specificities were considered as constraints that obligated teachers to adapt, simplify or discard initial ideas. In the words of Teacher 2, “every time we wanted to make things visually more attractive, we understood it was very complex to do, so we thought: ‘well, we will leave it as it is. I want the character to take something in another way, well, no’. In this sense, the software is not very user-friendly” (Annex 8.2.1). Hence, teachers asserted that the editor “forced” their creativity (Annex 8.2.1). Indeed, they constantly had to look for alternative solutions in order to implement their ideas. In the words of Teacher 1, “if we saw that an action we wanted to program was not easy to realize, we had to force our creativity to look for alternative options” (Annex 8.2.1).

As for Case 1, different types of intra-individual elements influenced the response generation stage. First, regarding intrinsic motivation, some antecedents and indicators of flow could be found in teachers’ discourse. They argued that they enjoyed solving the challenges they encountered, as well as seeing the game progressing towards their final goal. Second, the stage was influenced by teachers’ orientation towards working hard, during a prolonged period of time, as well as their willingness to overcome obstacles. Indeed, despite of the difficulties they encountered, they managed, by themselves and with persistence, to solve the problems and move forward. As expressed by Teacher 2, “we fought with the editor and we solved it” (Annex 8.2.1).

d) Stage 4: response validation (2RV)

The LG experienced several changes from teachers’ original idea. The following paragraphs detail these adaptation cycles.

Response validation criteria (3RVC)

As mentioned earlier, teachers maintained the core idea of their LG all along the design process. Hence, once they agreed on learning contents, they did not re-evaluate it. Nevertheless, as they discovered the editor’s functionalities, and according to their technical skills, they constantly adapted the game interactions in order to achieve a working game. As voiced by Teacher 1, “you can try out many ideas, but if editing actions is too complex, you have to discard them” (Annex 8.2.1). Furthermore, in the words of Teacher 2: “we tried to simplify in order to be able to reach our objective”, and “we came with a lot of ideas, but we dismissed them, because we didn’t know how to develop them” (Annex 8.2.1).

Response validation strategies (3RVS)

Teachers evaluated and adjusted their ideas through "a constant process" (Annex 8.2.1), through the following strategies:

- *Self-testing with the editor:* they tested the feasibility of their ideas with the editor, through a "trial and error" process (Annex 8.2.1). They continuously adapted the game elements when necessary, until achieving a working game. Furthermore, as they were learning how to manage the functionalities of the editor, they discovered how to improve previously designed elements, and could refine the game little by little. As voiced by Teacher 1, "now that we know how to use this, we are going to improve this part" (Annex 8.2.1).
- *Peer review:* only near the end of the design process, teachers showed the game to their colleagues for play-testing. Their comments were taken into account for last improvements on usability aspects.
- *Play-testing with students:* students also discovered the game at the end of the design process. They provided some comments and feedback, mainly on usability topics, which were written down by teachers. These suggestions will eventually be taken into account in the future.

In contrast with Case 1, the team did not ask for any support to the researcher. Indeed, their objective was to design the game in an autonomous manner.

e) Stage 5: outcome (2OUT)

The following paragraphs describe teachers' overall satisfaction with the LG created, as well as the way they spread it among the community.

Outcome evaluation (3OE)

Teachers were satisfied with their game, and considered having achieved their objective, i.e. designing a game and testing the potential of GBL and the eAdventure editor. Furthermore, they were satisfied of having taken up this challenge. In the words of Teacher 2, "for us, it was spectacular to achieve that the character moved" (Annex 8.2.1).

Nevertheless, they did not consider their game to be attractive for students, who are used to play commercial games with a higher quality of graphics and interaction. To Teacher 2, "it is very difficult to make a game attractive for our students, who are regular players. We are competing with professional games, which are very well elaborated, with a better graphical quality" (Annex 8.2.1).

Furthermore, teachers were not satisfied with some aspects of the game. For example, they stated that the interactions and the characters could be more dynamic. In spite of their efforts, "the character still walks like Robocop" (Annex 8.2.1).

Beyond the game itself, teachers considered having reached their objective, i.e. working with ICT in a collaborative manner. As expressed by Teacher 1 when referring to the whole experience: "it was rewarding, not so much for the final outcome, but for the process, in this case, working together on a digital game" (Annex 8.2.1).

Communication (3COMM)

Teachers have not diffused their game outside of the classroom. To them, the game objectives are specific, and can only be applied in their particular teaching context: “it’s only valid for the context it was designed for” (Annex 8.2.4). Furthermore, they believed that “for external audiences, it is not a very well done game” (Annex 8.2.1).

Nevertheless, teachers showed the game to their colleagues, who gave positive feedback on the result: “when we presented the game, it appeared as a surprise, even admiration, to see that we were able to design such thing” (Annex 8.2.1).

As a next step after the design process, teachers plan to conduct a learning activity in which students would design a game. To Teacher 2, “this would engage them much more”. Indeed, “it is more fun to create the game than to play with it” (Annex 8.2.1).

2.1.2. Collaborative game design (1CGD)

This section describes the collaboration processes at stake among the two teachers of Case 2 during the design of the game *Tuning up a Bicycle*.

a) Group members (2GM)

Group history (3GH)

Teachers chose to conduct the project together as they had previously collaborated in the context of other activities. As mentioned by Teacher 2, “to a personal and professional level, we are used to deal together” (Annex 8.2.1). Hence, their partnership was characterised by a shared history, which favoured a common work culture and mutual trust. As expressed during the interview (Annex 8.2.1):

> Teacher 1: We know at each other’s. I think that trust is completely mutual [laughter].
> Teacher 2: And we work well together.

Members’ profiles (3MP)

Group members had different professional profiles. As for Case 1, one of them, as teacher of the discipline taught in the game, was expert in the domain. In contrast, the other had higher technical skills. In spite of their different professional expertise, teachers shared the same objectives for the game, since the moment they agreed on them.

b) Group processes (2GP)

Legislation (3LEG)

Teachers shared the different tasks involved by the game design process, according to their respective skills. The teacher who was expert in the knowledge domain led the elaboration of contents and the creation of resources: photo and video shooting. Indeed, he had regular contact with students and could easily involve them in this task. On the other hand, the second teacher focused on the programming part, as his informatics skills enabled him to manage the software functionalities.

Distribution of tasks (3DT)

Distribution of tasks was done according to a mutual agreement, in a spontaneous and informal way, without any pre-established rule. In teachers' words: "we meet every day, we didn't need to establish rules, we were in continuous contact" (Annex 8.2.1). Furthermore, teachers were flexible, and easily changed their roles when necessary. For example, when the programming part involved a pick of work, the first teacher spontaneously helped the other. Both teachers considered that the workload was equally distributed during the whole design process.

Leadership (3LEAD)

Leadership was distributed among the two teachers. Indeed, each member of the team coordinated an aspect of the work. Furthermore, decisions were made on the basis of a mutual agreement.

Members communication (3MC)

Generally, teachers communicated in the premises of their educational centre, through regular meetings in which they decided how to share the tasks. In contrast, some steps of the design process, such as the production of resources and the final edition, involved intensive work cycles. In those cases, teachers multiplied communication processes and channels, using e-mails, chat, and phone. As mentioned by one of the teachers, "we were available to each other; if anything was necessary we talked about it" (Annex 8.2.1).

Members relationships (3MR)

It was possible to observe several indicators of positive and trustful relationships during the interview, such as laughs, jokes and positives references to the team. Furthermore, teachers mentioned several times a good connection among them.

c) Advantages of collaborative game design (2ACD)

To teachers, collaborative design had positive impacts on different aspects:

- *Motivation:* to teachers, working in pair was critical in order to achieve the final result: "when you have to do something by yourself, you can decide to give up. But when you are involved with somebody, you feel responsible and more motivated" (Annex 8.2.1). Furthermore, they considered it more pleasant to work by group than individually.
- *Idea generation and evaluation:* teachers argued that the fact of having different perspectives on a common project facilitated the generation of solutions. Furthermore, a second point of view can make decision processes easier: "decisions are more automatic when you work alone. But if we are two, we comment, and we choose to keep or discard the idea in a more confident way" (Annex 8.2.1).

d) Challenges of collaborative game design (2CCGD)

Teachers did not outline any challenge regarding collaboration.

2.2. Product dimension

As for Case 1, this section analyses creativity in relation to the LG and GBL scenario created by teachers (Annexes 4.2.1 and 4.2.2), according to gaming aspects, pedagogical aspects, usability, and innovation. Analysis was performed on the basis of data collected with interviews conducted with two experts in the field of GBL (Annexes 8.2.2a and b), and with the two teachers from Case 2 (Annexes 8.2.3a and b).

Furthermore, in order to triangulate data, a questionnaire was used with 12 students after they played the LG *Tuning up a Bicycle*. The different factors explored in the questionnaire enabled to collect students' experience regarding the following aspects of the product dimension: balance of difficulty (through the challenge factor in the questionnaire), clarity of goals (through the goal clarity factor), clarity and constancy of feedback (through the feedback factor), easiness of use (through the autonomy factor), immersion (through the immersion factor). The results of the questionnaire are available in Annex 8.2.5. Table 20 and Figure 28 illustrate the results of the questionnaire per factor.

Factors	Mean	SD	Median	Mode	Variance	Minimal	Maximal
Goal clarity	4,00	0,43	4,00	3,50	0,18	3,50	4,50
Challenge	3,53	0,88	3,50	3,33	0,78	1,33	4,67
Feedback	4,14	0,88	4,33	4,33	0,78	2,00	5,00
Autonomy	4,25	0,54	4,50	4,50	0,30	3,50	5,00
Innovation	4,04	0,86	4,00	5,00	0,75	2,50	5,00

Table 20: Results of students' questionnaires per factor (product dimension) - Case 2 (*n* = 12)

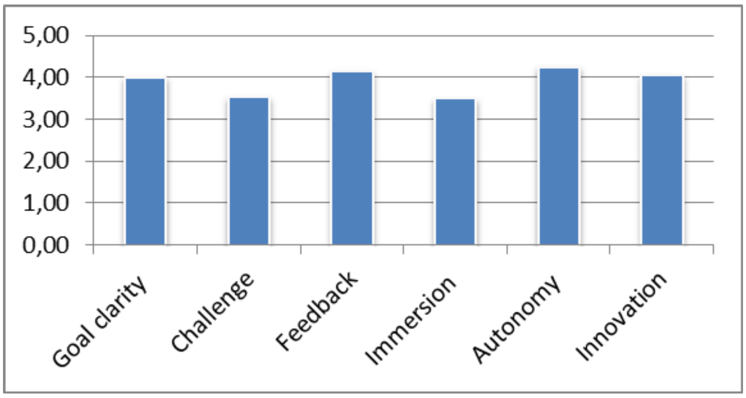

Figure 28: Results of students' questionnaires - Means per factor (product dimension) - Case 2 (*n*=12)

2.2.1. Usefulness (1USE)

a) Gaming aspects (2GA)

Clarity of goals (3GOALS)

Both teachers and experts stated that the game objective is clearly defined and explained to students at the beginning of the game, through the mechanic character and the book provided to the player. Furthermore, one of the teachers outlined that students immediately understood what they had to do. This was confirmed by the results of the questionnaire, as the factor goal clarity scored high (*M* =

4.00, SD = 0.43). Students agreed that the instructions of the game were clear (M = 4.08, SD = 0.67) and that they knew what they had to do (M = 3.92, SD = 0.90).

Nevertheless, to experts, intermediary objectives are not clearly explained. Indeed, the player is not reminded, along the game, of how many elements he has to check and how many tools he should use.

Balance of difficulty (3DIFF)

Expert 1 considered difficulty to be adequately balanced according to the profile of students. She found it consistent with the context of use of the game, i.e. as a context for students to practice knowledge acquired earlier. In her words, "maybe someone who masters the topic would solve the game in two minutes, which would not be of much interest. But for practicing, it is totally correct" (Annex 8.2.2a). Nevertheless, she suggested that some difficulty elements could be added (e.g. time counting) in order to foster challenge.

To Expert 2, the game does not present any difficulty at a pedagogical level. To him, challenge is related to the resolution of usability concerns: "the difficulty augmented because interactive zones were hidden, which does not bring anything" (Annex 8.2.2b).

To teachers, the level of challenge varies according to students' level of knowledge: "for those who master the topic, it's very easy. For others, it's fine" (Annex 8.2.3a). Generally, they considered the game "a bit too easy" (Annex 8.2.3b). However, they stated that some students played again in order to practice their knowledge until mastering it.

Finally, students mentioned that they would have liked to learn deeper knowledge through the game, by "going deeper in all the actions that they know" (Annex 8.2.6). Regarding the questionnaire results, the total score for the challenge factor was high (M = 3.53, SD = 0.88). Students agreed on saying that the game was challenging, but that they felt capable of solving it (M = 3.67, SD = 1.30). Nevertheless, they partially agreed on saying that the game was neither too difficult nor too easy (M = 3.33, SD = 1.30).

Clarity and constancy of feedback (4FEED)

Expert 1 stated that the character correctly responds to the actions conducted by the player. However, she argued that only one indicator informs the player on his progression, i.e. the check marks. Hence, she suggested adding more feedback elements, such as indicators of the time used and the quantity of errors made before solving the game.

To Teacher 1, the game presents both progressive (i.e. check marks appearing in case of correct action) and final (i.e. videos) feedback elements: "while they are adjusting the brake, if they do it well, they obtain a partial reward; and at the end, they get the video" (Annex 8.2.3a). However, to Teacher 2, the game lacks some intermediary feedback elements: "although a check mark appears each time students do something correctly, only at the end they know if they did it right or not" (Annex 8.2.3b).

According to the questionnaires' results, students considered feedback sufficient (M = 4.14, SD = 0.88). They agreed on saying that the game correctly answered to their actions (M = 4.25, SD =

1.22), informed them on their successes and failures (M = 4.17, SD = 1.40) as well on their progress (M = 4.00, SD = 1.41).

Clarity and consistence of rules (4RULES)

Teachers and experts agreed that rules are consistent all along the game. Teachers argued that all the rules are presented in the instructions book given to the player at the beginning of the game. Nevertheless, experts stated that the interaction rules are not clearly explained. As a result, players have to learn how to use the game through a process of trial and error. Hence, experts suggested that some instructions should be given to players, so that "they can focus on the learning objectives" (Annex 8.2.2a). Finally, Expert 2 argued that the games rules consist of searching for interactive zones on the scenes, instead of searching for elements to be fixed on the bicycle.

Immersion (4IMMER)

To teachers, the immersive potential of their LG is related to the proximity of the environments of the game with those of students' everyday life: "the initial screen is the entrance of our workshop, they know it well. The next screen, they recognize that it is inside the workshop. The screen of the panel is our panel. There is nothing special, the tools are the ones they know, that they have used. The environment is totally close to them" (Annex 8.3.2a); "I think that it was attractive to them to recognize the graphics, the tools, the environment, because it is from their own workshop" (Annex 8.3.2b). In contrast, teachers argued that graphical elements (i.e. the quality of pictures, the size of images, and the animation of characters) could be improved in order to be more attractive to students.

Expert 1 agreed with teachers. She outlined that pictures can facilitate students' immersion and engagement, as they correspond to their daily environment, are realistic and pleasant. Furthermore, the protagonist is one of their colleagues. In the expert's words: "for players major from 18, the use of pictures is appropriate, I mean, it is not a game for children" (Annex 8.2.2a). However, she outlined that the quality of pictures, and the visual aspect of the game in general, could be improved. Furthermore, she argued that an audio theme would enhance students' engagement. She mentioned that the game is "fun, motivates to play, and is simple". As there is no time limit, she felt free to try out many options. Nevertheless, she suggested that the player should be able to try to run the bicycle when he wants to, without having to repeat the whole game in case of missing some element.

To Expert 2, the game seriously lacks elements of immersion. To him: "teachers intended to create a game, but they created a system which consists of searching for interactive zones" (Annex 8.2.2b). To him, the game does not invite to play again.

Questionnaire's results showed that students' opinions towards immersion was unclear (M = 3.49, SD = 0.60). The item "time passed very quickly while playing the game" scored high (M = 4.25, SD = 0.97), which demonstrates that students generally experienced a transformation of time, in comparison to common lectures. However, as for Case 1, students partially agreed on saying that they were able to forget about their surroundings (M = 3.00, SD = 0.74). They agreed on saying that they enjoyed playing (M=3.58, *SD* = 0.90), and that they felt involved with the game (*M* = 3.67, *SD* = 0.89).

b) Pedagogical aspects (2PA)

Clarity of pedagogical objectives (3PO)

To teachers, the pedagogical objective proposed in the game is simple and clear, i.e. to strengthen content on the necessary steps to tune up a bicycle before using it. Expert 1 agrees that the educational problem is clearly defined and concise.

Nevertheless, both experts argued that the pedagogical objectives covered by the game are rather superficial. To Expert 2, "I would have liked to have a closer look to the functions of each tool: how it should be used, what is the most important element of the tool. Because you may use the right tool on the bicycle, but in a wrong way. This is not transmitted through the game" (Annex 8.2.2b). Teachers recognized the simplicity of the objectives addressed in the LG. They argued that their intention was to introduce more content and more complex tasks to the game, but that they had to simplify their objectives for feasibility constraints.

Connection to the curriculum (3CURRI)

Both teachers and experts argued that the knowledge taught through the game directly matches the curriculum of the discipline. As mentioned by Teacher 2, "the game is based on the curriculum, it is part of what they need to know" (Annex 8.2.3b).

Alignment of game play and pedagogical objectives (3ALIGN)

To teachers, the pedagogical objective addressed can be achieved through playing the game. Indeed, all the educational contents related to this objective are synthetized in the game. To Teacher 1, "we managed to synthetize everything in 10 steps, and it is quite simple to understand" (Annex 8.2.3a).

Expert 1 also argued that reaching the game objectives involves reaching the pedagogical objectives stated in the scenario. Indeed, in order to solve the game, players have to apply their knowledge by correctly associating the tools with the components of the bicycle: "when you finish the game, and you don't fall off the bike, it means you managed to learn content, understand it and apply it" (Annex 8.2.2a). Nevertheless, one of the pedagogical objectives stated in the scenario is to make students aware of the importance of checking their bicycle before going for a ride. The expert stated that this objective is only partly reflected in the game. Hence, she suggested adding an extra scene, in which the mechanic would explain the importance of checking one's bicycle.

Expert 2 argued that the pedagogical objectives addressed in the scenario cannot be reached by playing the game. To him, "the game is a trial and error, but there is nothing which helps memorizing the elements of the bicycle" (Annex 8.2.2b). Rather, the game consists of "searching for interactive zones on the screen, instead of searching for the right tools and elements of the bicycle" (Annex 8.2.2b).

Appropriateness to the profile of the students' group (3APPRO)

Both teachers and experts considered pedagogical objectives totally adapted to students' age and profile. Indeed, as mentioned by Teacher 1, "the game was created for students of this profile in particular, who have specifically previously worked those content theoretically and practically. Thus, it is completely directed to them"; "the game wouldn't match any other group in the centre, it is specifically for them" (Annex 8.2.3a). Experts agreed on this point, as they argued that the level of personalization of the game environment matches students' specific profile.

Planning of complementary activities (3ACTI)

To Expert 1, the game is well embedded in the planning of the discipline, and set in meaningful educational activities, i.e. the introduction to the topic through a book, a practical session in the workshop, and a posterior collaborative debriefing session. In her words, "it is clear that the game fits where it is, from a pedagogical point of view, I see it very well integrated" (Annex 8.2.2a). However, she recommended adding more collaborative aspects to the scenario. For Expert 2, the game correctly enables students to remind what they previously work in the bicycle workshop. However, he believes that all LGs should allow for self-learning, so "a person who does not know anything about the topic can learn something" (Annex 8.2.2b).

To teachers, the game is correctly embedded in the activities of the course. They argued that it enables to strengthen knowledge previously acquired. In the words of Teacher 1, "it wouldn't have made sense to use the game at the start of the course" (Annex 8.2.3a).

Pedagogical evaluation (3EVAL)

The evaluation of students' knowledge is ensured by a post-test which is not included in the game. To Expert 1, the evaluation strategy is effectively planned. However, Expert 2 is more critical, and argued that "the game is not a study material, thus, it is not possible to evaluate the knowledge acquired" (Annex 8.2.2b). As for teachers, the evaluation strategy planned in the scenario is adequate. Furthermore, they argued that the game enables students to self-evaluate before the exam.

Adequate use of documentation resources (3DOCU)

Expert 1 considered that the instructions book provided at the beginning of the game is well elaborated, funny, and provides the necessary information to players. In contrast, she suggested adding links to external resources, such as books or a bibliography. Expert 2 considered the bicycle picture as a useful learning resource, as it is big enough to display details of each element. However, he argued that the pictures of tools are too small to allow for learning. Furthermore, he suggested adding some additional resources, such as pictures and videos illustrating gestures and procedures, e.g. how to blow a tire.

Planning of necessary resources (3RES)

To experts and teachers, the resources planned in the GBL scenario perfectly match the context of use of the game. Indeed, the duration of the game session (i.e. 30 minutes) is appropriate in the context of the classroom. Furthermore, the necessary technical resources are adequate, as each student has access to a laptop in the centre, and the game is playable directly online, or easily downloadable in case of connection problem.

Attention to diversity (3DIV)

To experts, this issue is not addressed in the game. Expert 1 argued that this criterion is difficult to implement. However, she suggested that students should be able to choose the sex of their avatar, and that the game could also be available in Galician language, although she does not considered this point as critical.

c) Usability aspects (2UA)

Easiness of use (3EAS)

Expert 1 considered the LG rather intuitive, although she encountered difficulties and experimented frustration at the beginning of the game: “at first, the game seemed difficult to manage, so it was not fun. But when you get it, you can enjoy it” (Annex 8.2.2a). To her, a simple initial guide, or just a drawing, would help players to learn the functionalities easily (e.g. the functions of the right and left clicks, the possibilities to interact with objects, etc.). She recommended including instructions within the game, in order to have a complete game and more powerful messages.

To Expert 2, the game presents serious usability problems. First, he argued that the player is not autonomous. Indeed, in many occasions, he did not know what to do and spent time searching for options: “to be autonomous, the player should be able to access, in any moment, an icon with help about what you can do: ‘the way out is this way’” (Annex 8.2.2b). Second, while interacting with tools or elements of the bicycle, he had to search for the interactive zones: “there are elements which are easy to find, and others which are difficult. When you don’t know which element you have to search, it becomes frustrating” (Annex 8.2.2b). Hence, he argued that the objective of the game becomes searching for interactive zones, which is related to usability aspects, instead of learning aspects.

Teachers considered the game correct regarding usability, in spite of small problems, which they could not correct. As expressed by Teacher 1, “I think that the game is easy to use for them. They are all used to play other games, and the actions of this one are quite simple. Maybe it is more difficult for us, because we are less used to it” (Annex 8.2.3a). However, teachers stated that they would have liked to integrate a help function, in order to guide students in case they do not find the way to conduct an action. In the words of Teacher 1, “there is no help in the game. I don’t know how to create one. There were students who would have needed it. In this case, we helped them ourselves” (Annex 8.2.3a). Furthermore, teachers would have liked to improve the interaction between students and the game: “instead of having to talk to the character, it would be better if he talked to you; if you could take a tool, instead of clicking on it to take it” (Annex 8.2.3b).

Students also outlined some usability problems, such as the size of the cursor and the interactive zones (the cursor is too big, so it is difficult to point small interactive zones), as well as the position of interactive zones, which are too close to each other’s (Annex 8.2.7). Nevertheless, questionnaires results showed that they did not meet any major difficulty regarding usability. Indeed, the autonomy factor scored high (M = 4.25, SD = 0.54). Most students agreed that the game functionalities are easy to manage (M = 3.92, SD = 0.67) and to learn (M = 4.58, SD = 0.79).

Minimizing of errors and dead points (3ERR)

To experts, the scenes that present interactive elements do not present any errors or dead point. Nevertheless, they both highlighted some moments in which they did not know what they had to do, and recommended adding more indications to guide the player.

Easiness of installation of the game (3INSTAL)

Both teachers and experts argued that the game is easy to install and does not require any complicated procedure or material.

Compatibility (3COMPA)

Experts considered compatibility perfectly adequate to the context of use of the game.

Accessibility (3ACCES)

Experts mentioned that it should be possible to increase the size of the font. Furthermore, they stated that sound elements could be added in order to improve the accessibility aspect.

2.2.2. Novelty (1NOV)

a) Little-c creativity (2LCC)

Teachers (3TEACH)

Teachers considered the LG to be innovative in comparison to the resources they habitually use in their teaching practices. Teacher 1 argued that it was innovative, to him, to integrate videogames in the classroom activities, and to leave students learn in an autonomous manner. In addition, creating their own digital game was highly innovative for teachers. Indeed, as stated by Teacher 2 “one of the main impacts of the course is to know that you are able to create a game, although you cannot compare it with commercial games” (Annex 8.2.3b).

b) Middle-c creativity (2MCC)

Students (3STU)

To Expert 1, the learning methodology supported by the LG was innovative in comparison to what students know: “as a game to practice, it can help students and motivate them” (Annex 8.2.2a).

To teachers, the game also represents an innovative educational resource for students, as they are not used to work this type of content through digital games. However, it is not an innovative game to them, as they are used to professionally developed tools. As mentioned by a teacher: “the game is more innovative for the teacher than for the student. To the student, the surprise is that the game is elaborated and designed for them, I mean, specifically for this class. But, as a game, it results very basic” (Annex 8.2.3b). Furthermore, “if you present them the result as a videogame, students expect a videogame; and then, they find a game similar to the ones of the 70’s” (Annex 8.2.3b).

Finally, students considered the LG to be innovative. Indeed, the innovation factor scored high (M = 4.04, SD = 0.86). Students agreed on saying that they were not used to see this type of activities in the school (M = 4.42, SD = 0.79), and that this way of learning was new to them (M = 3.67, SD = 1.37).

Educational centre (3EC)

Although ICT is widely used in their educational centre, teachers argued that it is innovative to use digital games as a resource for teaching the specific content of a discipline.

c) Big-C creativity (2BCC)

Existing learning resources (3ELR)

To Expert 1, the game represents an innovative methodology in comparison to books and slides, which constitute the resources habitually used by teachers. She also argued that the game is innovative regarding the resources that are regularly used within the Spanish vocational training and secondary education system. Indeed, she mentioned that digital games have only recently started to be used. Furthermore, she stated that, pedagogically, the game represents an activity centred on students, practical, which promotes active and discovery learning. To her, "even if vocational training programs are quite practical, the fact of being able to practice without fearing mistakes is interesting" (Annex 8.2.2a).

To teachers, the game is innovative as no similar resources exist for working content related to this specific discipline. Nevertheless, they stated that the game should be further developed and improved (i.e. the content, interactions and graphical elements) in order to be really considered innovative.

In contrast, Expert 2 outlined that he had seen similar games on the Internet, and did not consider the LG an innovative learning resource.

Existing games (3EG)

To both teachers and experts, the LG is not innovative, and cannot be compared to other games that are available on the market. In the words of an expert: "I consider it a game, it's entertaining and fun, and it has many aspects of a digital game, which are correctly applied to pedagogical objectives. But I don't think it is innovative in the market of digital games". Furthermore, "the novelty is that a teacher can use such a tool. However, the game per se is not really innovative regarding what exists on the market" (Annex 8.2.2a).

2.3. Teaching dimension

In this section, I focus on creative teaching and learning processes at stake during the application of the LG *Tuning up a Bicycle* in the classroom. The analysis takes into account results from the interview with Teachers 1 and 2 (Annex 8.2.3a and 8.2.3b). It also takes into account students' questionnaire results (Annex 8.2.5) and the classroom observation report (Annex 8.2.6).

2.3.1. Teachers' experience (1TE)

a) Organization of the GBL activities (2ORG)

Following the GBL scenario, the teacher first presented the steps necessary for tuning up a bicycle in class, with the support of a book. Then, through hands on activities, they practiced the procedure in the bicycle workshop of the school. Afterwards, they played the LG in class, in order to reinforce the knowledge acquired through the previous activities. The teacher organized a short debate in which students expressed their opinion on the game and on the elements of knowledge it addressed. Finally, they were evaluated through an exam.

Hence, the role of the game was to review and practice previous knowledge acquired in a different context. It offered students another perspective towards the same content. Furthermore, it relates to the "world outside the classroom" (Annex 8.2.3a), as students will be able to directly apply the game content in outside settings. This matches the context of the training program, which is "thought to be adapted outside the classroom" (Annex 8.2.3a). To teacher 1, the game also served as a self-evaluation of students' knowledge.

b) Role during the game session (2RGS)

First, the teacher explained students how to download the game, and introduced students to the pedagogical objectives of the session. He reminded them that he and his colleague designed the game, and explained it was more modest than a commercial game. In addition, the teacher gave some instructions. He told students that the goal was not to solve the game in the most rapid way; rather, they should not forget any of the 10 steps.

Afterwards, students started to play individually, each one on a different laptop. The game session lasted for 10-15 minutes. During this time, the teacher observed his students and provided help when he considered it necessary. Indeed, students spontaneously asked him when they met a persistent difficulty. Furthermore, in some cases, the teacher spontaneously gave instructions and clues to students when he saw them with difficulties or doubts: "maybe you forgot something"; "the mechanic man is our friend" (Annex 8.2.6). He often linked the problem encountered with what was learnt in the context of the previous activities: "think about the real mechanics of the bike" (Annex 8.2.6).

To the teacher, the GBL session represents a new activity in comparison to his current teaching methodologies. Thus, "a part of uncertainty" characterized his practice: "in the initial presentation, it is necessary to provide information, but maybe not too much, in order to see if students, autonomously, are able to solve tasks" (Annex 8.2.3a). He stated that he improvised, during the GBL session, to evaluate whether it was necessary or not to provide help to students, to guide them, or to leave them solve problems by themselves.

In consequence, the way of leading the classroom was different than for other sessions, in which the teacher constantly directs students. Here, his role was more "passive", as students participate more, are more concentrated, which enabled him to focus in enhancing learning processes where necessary.

According to the results of the observation and the interview, the climate of the classroom was very relaxed and quiet. Students were acting freely. In the words of Teacher 2, "to them, it's a different class, more relaxed".

2.3.2. Students' experience (1SE)

As for Case 1, I explored students' experience during the game session. To do so, I explored different aspects (immersion, concentration, autonomy, social interactions and achievement of the pedagogical objectives), considering data collected through interviews with Teachers 1 and 2 (Annex 8.2.3a and 8.2.3b). I also examined the observation report (Annex 8.2.6), and at the results of students' questionnaires (Annex 8.2.5). Results of the questionnaire per factor are shown in Table 21 and Figure 29.

Factors	Mean	SD	Median	Mode	Variance	Minimal	Maximal
Autonomy	4,25	0,54	4,50	4,50	0,30	3,50	5,00
Concentration	3,75	0,97	4,00	4,00	0,93	2,00	5,00
Immersion	3,49	0,60	3,58	3,83	0,37	2,17	4,33
Social interactions	3,00	0,86	2,83	2,67	0,75	1,67	4,33
Knowledge improvement	4,08	0,58	4,00	4,80	0,34	3,40	4,80

Table 21: Results of students' questionnaires per factor (teaching dimension) - Case 2 (*n* = 12)

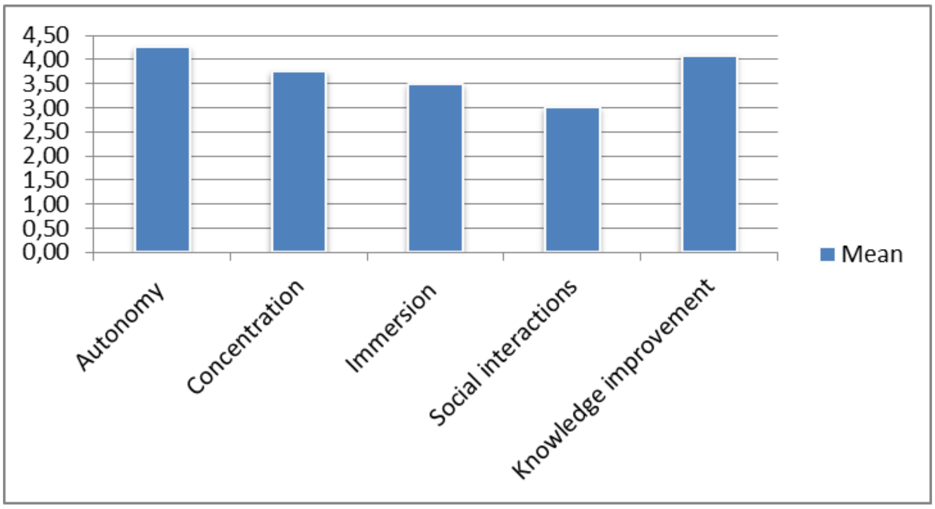

Figure 29: Results of students' questionnaires - Means per factor (teaching dimension) - Case 2 (*n*=12)

a) Engagement (2ENG)

Immersion (3IMM)

Teachers argued that students were engaged, absorbed, and had fun during the game session. Furthermore, the observation showed that they remained focused on the game during the whole session, and highlighted positive behaviours, such as laughs and smiles, either individually or collaboratively, in relation to the game characters and interactions. All conversations among students were related to the game. In addition, some students started to play again after having accomplished it once. When students finished the game, they often helped their classmates.

As mentioned earlier, the questionnaire's results revealed that students' opinions towards immersion were not clear. Students generally experienced a transformation of time during the game session, enjoyed playing, and felt involved with the game. In contrast, they partially agreed on saying that they were able to forget about their surroundings.

Concentration (3CONC)

Teachers stated that students were concentrated on solving the game during the whole session. They sometimes interacted together in order to solve doubts related to the game's functionalities and content. Nevertheless, one of the teacher mentioned that, once students had solved the game, the classroom was disorganized, as they started to chat or to surf on the Internet.

The observation results corroborated teachers' discourse, as they showed that students kept their focus on the game all along the session. They did not show any distraction, and stayed concentrated towards the activity until they solved the game.

Regarding the results of the questionnaires, the concentration factor scored high (M = 3.75, SD 0.97). Students agreed on saying that that they were totally concentrated (M = 3.92, SD = 1.08), and that it was easy to not get distracted during the game session (M = 3.58, SD= 1.08).

Autonomy (3AUTO)

Both the interviews and the observation showed that students were autonomous when interacting with the game. They very quickly and naturally managed its functionalities. They sometimes interacted together in order to solve some usability doubts, but rarely needed to ask anything to the teacher, and successfully accomplished the game tasks.

As mentioned earlier, questionnaires results showed that students easily learnt how to use the game, and did not encounter problems in using its functionalities. Indeed, the autonomy factor scored high, as students considered the game functionalities to be easy to manage and to learn.

Social interactions (3SI)

Students played the game in an individual manner. Nevertheless, as perceived during the observation, they interacted together in order to help at each other's when necessary. They pointed at their classmates' screen to show them how to solve some points, spontaneously or because they asked. As mentioned by Teacher 2, the help they provided to each other's was generally related to usability aspects. As an example, one student showed another how to open the mechanics book.

The social interactions factor received the weakest score among all factors (M = 3.00, SD = 0.86). For example, students partially agreed on saying that they were talking to their classmates while playing (M = 3.17, SD = 1.47). Similarly, students' answers regarding their collaboration with their classmates (M = 3.33, SD = 1.15) and with the teacher (M = 2.50, SD = 1.31) to solve some of the game's tasks were lower than for other factors.

b) Achievement of the pedagogical objectives

To teachers, the game session perfectly enabled to fulfil the pedagogical objectives addressed in the LG, i.e. reinforcing knowledge previously learnt in the context of hands-on activities, related to the steps necessary to conduct in order to tune up a bicycle. Teachers considered these objectives to be achieved, as all students were able to solve the game.

The knowledge improvement factor scored high in students' questionnaires (M = 4.08, SD = 0.58). In line with teachers, they agreed on saying that they could apply knowledge they learnt in class (M = 4.42, SD = 0.90). Furthermore, they strongly agreed having understood what the game wanted to teach them (M = 4.58, SD = 0.41). Finally, they strongly agreed saying that the game motivated them to learn (M = 4.75, SD = 0.45), and that they want to know more about the topic taught in the game (M = 4.58, SD = 0.57).

2.4. Teachers' perspectives on creative pedagogies

To the teachers interviewed, creative teachers are aware that learning is possible through different forms, such as words, games, questions, and projects. They use various types of resources, to the extent that they are applicable to contents, enable to reach planned results, are pleasant and attractive for students, so to call their attention and to make learning more significant.

Teacher 1 argued that his discipline involves many creative practices, in which he conducts outdoor activities that are directly related to the outside world. Furthermore, he organizes various types of learning activities such as contests, projects and simulations.

Teachers considered the game design experience to be creative. As Teacher 1 puts it: "a creative process consists of seeing something in a different way and doing something in a different way. In this sense, it was a creative process" (Annex 8.2.3a). To them, the methodology represented a valuable challenge, which they had to solve in order to reach an outstanding goal: create a videogame.

3. Case study 3: design and application of the LG the Holy Torq

In this section, I look at the design and application of the LG *the Holy Torq* (Annex 4.3.1) by the group of teachers from Case 3, from the centre CEIP Ponte dos Brozos.

3.1. Process dimension

As for the previous cases, this section describes the process through which teachers from Case 3 designed their LG. It first discusses their experience during each stage of the design process, as well as the influences of the person and press dimensions on these stages. Afterwards, the section describes the collaborative processes at stake among teachers. The discussion mainly relies on teachers' interview (Annex 8.3.1). In addition, it takes into account teachers' questionnaire results (Annex 8.3.4), and game design documentation (Annex 8.3.7).

3.1.1. Game design stages (1GDS)

In the following paragraphs, I present teachers' experience of the game design process, according to the different stages elicited in the conceptual framework.

a) Stage 1: task identification (2TI)

Engagement in the task (3ET)

As for the cases previously described, teachers learnt about the possibility of participating in the research through the Ponte dos Brozos project. Indeed, Teacher 1 is one of the coordinators of the initiative, and attended the focus group which was conducted during the exploratory study. He explained the research approach to his colleagues from the CEIP Ponte dos Brozos. All the interested teachers decided to collaboratively work on the same project. The team was composed of three teachers. Furthermore, five teachers participated in some tasks of the design process.

The participating teachers like to experiment and investigate innovative teaching methodologies. As expressed by Teacher 2, "we are always jumping into different things. We never stay in a way of working, we always have to do it different than before" (Annex 8.3.1). As they engaged in the task, they were searching for a new opportunity for innovating in their teaching practices. Hence, their motivation to participate in the study was related to discovering "new and different things, and ways of introducing new elements in teaching" (Annex 8.3.1). Teachers considered the idea of creating their own LG innovative. They wanted "to test the interaction between digital games and learning (Annex 8.3.4), and to experiment the potential of games in the context of pre-school and primary education contexts: "we didn't want to be transmitters of content but spectators waiting for the students' reactions of curiosity to a game" (Annex 8.3.7).

In addition, teachers aimed to enhance their students' motivation and to reach high learning outcomes. They considered GBL as "an engaging tool" (Annex 8.3.4), which can "enhance students' scholar performance" (Annex 8.3.1). Furthermore, teachers argued that their project started "from the desire to bring the school closer to students" (Annex 8.3.7).

Nevertheless, teachers stated that commercial games often do not meet the needs of formal teaching contexts, as they do not consider students' particular characteristics: "the games available usually have too long introductions, and their methodology doesn't consider what each student already knows" (Annex 8.3.7). Hence, they decided to create their own LG, which would connect to their curricular objectives and match their students' specific profiles.

Hence, both intrinsic (i.e. experimenting and investigating innovative methodologies) and extrinsic (to obtain effective and engaging resources) stimulated teachers for engaging in the design process.

Definition of the game's pedagogical objectives (3DPO)

During a brainstorming session, teachers defined the objectives of their LG. They aimed to reach all teachers' pedagogical objectives and students. Hence, they chose to work on a subject which would connect to all students, regardless of their age range, i.e. their history, cultural heritage, language, and the natural environment that surrounds them. The pedagogical objectives of the LG are resumed in the article written by teachers: "[the game] was aimed at students from the ordinary classroom for building their own knowledge of their cultural environment (customs, culture, history) and of the Galician language (reading, comprehension, vocabulary). Students would learn through observation, curiosity and communication with their peers through the game" (Annex 8.3.7).

b) Stage 2: preparation (2PRE)

Domain-relevant skills (3DRS)

In order to conduct the different tasks involved by the design process, teachers had to master different kinds of skills and knowledge, mainly technical skills related to the use of the eAdventure software, and factual knowledge about the domain. Indeed, in spite of their expertise in the domain of knowledge, teachers had to frequently search for information in order to create a valid and consistent game about the daily life in ancient Galicia. In the words of Teacher 1, "we had to find information about the dolmens, on the forts, on the torq, to not screw up, check if there were square forts, where was the door, if it was above, below, or in the trees. Check that there will be no historical inconsistency" (Annex 8.3.1).

Learning process (3LP)

As for the other cases, teachers learnt how to manage the main functionalities of eAdventure during the training workshop. Teachers argued that the training was intensive, and provided them with the sufficient skills to start designing their LG. The tutorials provided, as well as the examples of existing games created with the editor, helped them "to know what [they] wanted to develop, and more importantly what [they] did not want" (Annex 8.3.4). However, they only started to produce their game two months after. Hence, they needed to re-learn how to use the editor's functionalities and explore its possibilities, as they were evolving in the design process, in an autonomous manner. As expressed in teachers' article, "the teachers were also learners, we made mistakes, and we didn't succeed in the first attempts. Instead, we had to persist and keep working" (Annex 8.3.7).

c) Stage 3: response generation (2RG)

The next paragraphs describe the different steps by which teachers generated ideas and solutions to create their LG.

Conceptualization (3CONC)

Teachers developed the core idea of their LG (i.e. plot, objectives and characters) during a brainstorming session. The initial ideation process took into account the following parameters:

- *Teachers' educational contexts:* teachers aimed to develop an idea which could be useful in the teaching contexts of the different team members, i.e. which would match their curricular objectives and students' profiles.
- *Teachers' interests:* they came up with a concept which could call the interest of the different members of the team. Hence, they developed an idea related to their common culture. As voiced by Teacher 2, "we were looking for something close to our culture, it has always been something that called our attention" (Annex 8.3.1).

Teachers detailed their idea in a GBL scenario. As expressed by Teacher 1, "it has been positive that you obliged us filling in the scenario, it was important"; "it forced us to pull away" (Annex 8.3.1).

Teachers affirmed that they kept the same idea all along the design process. They considered that, from the beginning, they found an attractive idea and stuck to it. However, the idea was adjusted along the elaboration. In the words of Teacher 3, "it was shaped, it changed, and it was reviewed when it was ready" (Annex 8.3.1).

Elaboration (3ELAB)

On the basis of their core idea, teachers elaborated, on a collaborative basis, the different aspects of their LGs, i.e. the educational contents, the pedagogical design, the script and the dialogs.

Teachers detailed their idea into a storyboard, in which they described the different scenes of the game, as well as the characters, conversations, objects, conditions and effects. They considered this step useful to help them mapping the elements of the game before starting to implement it with the editor. In a teacher's words, "the first time one creates a game, one can get lost without doing a storyboard" (Annex 8.3.4).However, some teachers of the group stated that the elements defined in the storyboard had to be adjusted during programing process: "It is important to be clear with one's objectives, although when you faced the editor, you have to modify some ideas" (Annex 8.3.4). As a result, they argued that they sometimes preferred to work directly with the editor, in order to directly evaluate the feasibility of their ideas. As stated by Teacher 2, "the storyboard served as a guide for developing the game. However, I felt more confident working directly on the project through the editor" (Annex 8.3.4).

Production (3PROD)

Teachers have used two different types of resources in order to give life to their game, i.e. graphical and audio resources. The graphical elements were considered determinant, as they would enable students to immerse in the visual environment of ancient Galicia, through characters' clothes, houses' shapes and decoration. Teachers could not find any graphical elements which could reflect this specific environment. Thus, they preferred to contact a professional graphic designer in order to obtain tailored-made resources. As expressed by Teacher 1, "we've been lucky to contact the illustrator, who did a good job; a fabulous job" (Annex 8.3.1). For the characters' voices, Teacher 3 recorded her students, who suffer language disorders (hearing, diction and comprehension problems). This enabled her to reach parallel pedagogical objectives, as she could get her students to memorize texts, dare talking and being recorded for a game which would be played by external audiences. The teacher stated that this aspect of the design process was the most beneficial to her. It is resumed in the article written by teachers (Annex 8.3.5):

> The focus was on working on transversal skills through participation, i.e. the creation of the game with the help of students with special needs from the section on hearing and speech. These students had problems in the area of language, in their self-esteem and in their relation with their peers. Moreover, they were from different cultural backgrounds (Arabic, Romanian, gypsy.) and had various learning challenges (dyslexia, attention deficit.). Given this context, we decided that

> the speeches of the young characters in the game would be suggested, recorded and corrected by these students. In this way, they could also see how the videogame evolved as the teachers were working on it. We all worked together (…). The participation of the students helped to lift their self-esteem. They felt that their work was important as they were collaborating in the development of a game that their fellow students would play later and in which they would be the characters' voices (p. 71).

Teachers described the programing process as complicated, laborious, challenging and sometimes discouraging. Indeed, they constantly had to "fight" with the editor (Annex 8.3.1). As expressed by Teacher 1, "to achieve, through such a complicated, unfriendly platform, the realization of a game, without committing suicide, was a complicated process" (Annex 8.3.1). They could not manage to design the game interactions planned with the software functionalities. Furthermore, they sometimes did not understand the effects of the conditions they designed. As voiced by Teacher 2, "we went mad, one day it worked, the day after it didn't work" (Annex 8.3.1). Furthermore, they stated that the programming process became more complicated as they progressed in the development of the game. As a result, *t*eachers described the editor as "heavy, complicated, and not user friendly" (Annex 8.3.1).

To them, it "adds difficulties. It does not facilitate" the design process (Annex 8.3.1), as they had to discard many of their ideas because of its specificities: "some changes made were because of the type of working of the platform" (Annex 8.3.1).

As for the other cases, teachers' intrinsic motivation and creativity-relevant processes influenced the response generation stage. Indeed, challenge appeared to motivate teachers, while their persistence enabled them to overcome difficulties and obstacles. As stated in teachers' article, "we had to persist and keep working" (Annex 8.3.5).

d) Stage 4: response validation (2RV)

Teachers refined the different aspects of their game during the whole design process. For example, they planned, in their storyboard (Annex 8.3.5), to develop a map of different villages, which the player would be able to visit. However, the game only presents one village, and does not include any map. Data showed that they adapted their ideas according to the following criteria.

Response validation criteria (3RVC)

Teachers argued that they have been refining the elements of the game as they developed their knowledge about the domain. Furthermore, time limits obliged them to re-evaluate their ideas, i.e. to simplify them or, in some cases, to discard them, in order to achieve their project on time. As expressed by Teacher 3, "ideas keep on flowing, what would you do, how would you do it, but the time is here, we have to finalize" (Annex 8.3.1). Consequently, time pressured teachers and limited the emergence of ideas. In the words of Teacher 3, "some ideas emerge, and all of a sudden, you say: 'Ha! I can profit this part to'… but no, here is the time" (Annex 8.3.1). In addition, teachers adapted their ideas as the editor's functionalities did not enable their application.

Response validation strategies (3RVS)

Teachers continuously evaluated and adjusted their ideas, through an iterative process, employing the following methods:

- *Peer review:* as they worked as a group, teachers constantly tried and evaluated ideas, on the basis of each other's opinions. Their different profiles enabled to evaluate solutions in an objective manner. In the words of Teacher 2: "among us, besides the fact that we get along well, we are different. Thus, if he sees something he doesn't like, he tells us. If I see something I don't like, I tell it (…). We correct at each other's, we offer different visions" (Annex 8.3.1).
- *Online support:* the group of teachers maintained a close collaboration with the researcher, who provided insight on different aspects of the game, e.g. the storyboard, usability, and the elimination of dead points (Annex 8.3.7). Teachers generally applied those suggestions.
- *Play-testing with students:* students had the opportunity to test the game in many occasions. In the words of Teacher 3, "they were experimenting, so they would tell you: 'but this goes here!'" (Annex 8.3.1).
- *Testing and redesign with the editor:* as for the other cases, teachers constantly evaluated the feasibility of their ideas by trying to implement them with the editor, and validated, adapted or discarded them accordingly.

e) Stage 5: outcome (2OUT)

Outcome evaluation (3OE)

Teachers were generally satisfied with the result obtained, and considered having reached their objective, given the few resources they had. In the words of Teacher 2: "I take my hat off to our work"; "I think we did a great job. From the projects we did in group, I think it is the one of the most complete, and the one I like more. Maybe it is the pictures, but not only. It's a very complete work, very complete to work different topics. I like it, and I am very proud of what we've done" (Annex 8.3.1). Furthermore, as expressed by Teacher 2, "I think that what we have done could be improved, but I am very satisfied with the game, given our experience and the little time we had" (Annex 8.3.4).

However, teachers asserted that some aspects of the game are imperfect, due to the limitations of the editor. Despite of some possible improvements, teachers considered their game as a final product, which they do not plan to work on anymore: "now that it has been time I haven't touched the software, it would involve so much time to improve something" (Annex 8.3.1).

Communication (3COMM)

Teachers stressed that their game can be applied to various educational contexts in the region of Galicia. As a result, they have widely diffused it among the educational community. As voiced by Teacher 1, "it was published in press and in social networks" (Annex 8.3.1).

3.1.2. Collaborative game design (1CGD)

This section focuses on the collaborative processes at stake during the game design process. It describes both group members and group dynamics.

a) Group members (2GM)

Group history (3GH)

The group of teachers had already collaborated in previous projects before they undertook the task. In the words of Teacher 2, “with this team we have been working for various years. There is a basis of four, five, six people working together for a long time. Then, there are people who come in as they arrive to the school, according to their interests, and what they teach” (Annex 8.3.1). This shared history among the group members was described, by Teacher 1, as a success factor for an effective collaboration: “we had a big chance, is that our work group has established mechanisms. Within the group, we know when we have to work more and less, when we have to discuss, when we have to reach an agreement, and what we have to do” (Annex 8.3.1).

Members' profiles (3MP)

Teachers stated that the members of the group have different profiles and skills, which facilitated the collaborative design process. Indeed, they could share different visions and split tasks according to their respective competences.

In spite of their different interests, teachers always kept the same vision of the project objectives. Some team members worked on the game although it was not useful for their teaching contexts. As expressed by Teacher 1, “the most difficult, was that some people were pre-school teachers. They did great, because since the moment we made the decision that the focus of the game was not for pre-school, they could have left. However, they forgot this fact, and participated in the elaboration of the game, forgetting that it would not enable a practical and direct use with their students” (Annex 8.3.1).

b) Group processes (2GP)

Legislation (3LEG)

Teachers worked according to a “more and less defined” distribution of tasks (Annex 8.3.1). Indeed, they worked on different tasks, according to their respective skills and interests. In the words of Teacher 2, “I never participated in the script, like others never participated in the technical part. Because I am better at this, and the other is better at that. Thus, each person had a role, a part of the work, and took care of it” (Annex 8.3.1). Furthermore, the team had a planned timing, which was “made flexible according to each person's personal life, and the dates set to finalize the work” (Annex 8.3.1). Hence, teachers had a basis of rules for organizing work, which were flexible according to people skills, availabilities, as well as the evolution of the design process.

Distribution of tasks (3DT)

The distribution of tasks was made according to teachers' interests and competences. As expressed by Teacher 1, "part of the team took care of dialogs. Another part of the team concentrated on technology, while another part was devoted to documentation" (Annex 8.3.1). Afterwards, each aspect of the work was reviewed by the entire team, and changes were performed when necessary.

All members of the group equally participated in the design of the game. However, teachers prefer to not quantify members' dedications. In the words of Teacher 2, "people do what they can, and collaborate the way they want" (Annex 8.3.1).

Leadership (3LEAD)

All decisions related to the LG were made in a distributed manner. As voiced by Teacher 2, "we always decided in group" (Annex 8.3.1). Nevertheless, Teacher 1 had a strong impact on the group. He defined himself as the "catalyst" of the group (Annex 8.3.1). Indeed, he was the one who found out about the research, and proposed his team to participate. Furthermore, he had a global perspective of the different aspects of the design process. As explained by Teacher 2, "he had the global vision. We have a partial, cloudy vision (…). He has a vision that, the others, we don't have" (Annex 8.3.1). The leading role of Teacher 1 was considered to be natural, and well accepted by all team members.

Members communication (3MC)

The members of the group mainly communicated through face-to-face meetings. Furthermore, they sometimes planned or solved issues through e-mails. They usually met all together, but sometimes met in "subgroups" (Annex 8.3.1), in order solve issues specific to their assigned tasks.

Members relationships (3MR)

The group of teachers showed positive relationships and strong connections. They displayed trust, familiarity, flexibility and spontaneity. Teachers argued that they like to work together, which is the reason why they undertook the task voluntarily. As expressed by Teacher 2, "I always participate in group works, because I know I will be happy. I meet with people I like (…). It is something voluntary" (Annex 8.3.1).

c) Advantages of collaborative game design (2ACD)

Teachers positively valued the collaborative aspect of the design process. To them, the achievement of the LG would not have been possible without collaboration. The dialog below resumes their perspective (Annex 8.3.1):

> Teacher 1: Individually, it would have been impossible.
> Teacher 2: We wouldn't have tried to do it.
> Teacher 1: There wouldn't be a Torq.
> Teacher 3: Yes, there would be one, simpler and less successful.

Hence, collaboration enabled to lighten the workload implied by the design process. In addition, the heterogeneity of the group brought a multiple perspective towards the project, and enabled to obtain a richer outcome. Indeed, teachers argued that collaboration facilitated the emergence of ideas. Team work also helped teachers to be more persistent and keep on target. In the words of Teacher 3, "for the technical part, there were some moments, in which being two… If the other is not there, you would give up" (Annex 8.3.1).

d) Challenges of collaborative game design (2CCGD)

No challenges to collaborative game design were highlighted by teachers.

3.2. Product dimension

As for the other cases, this section explores product creativity, by analysing the LG and GBL scenario (Annexes 4.2.1 and 4.3.2) created by teachers according to different criteria, i.e. usefulness (gaming aspects, pedagogical aspects, and usability) and novelty. The discussion is mainly based on the interviews conducted with two experts in the field of GBL (Annexes 8.3.2a and 8.3.2b) and with Teacher 2 and 3 (Annex 8.1.3a and 8.3.2b).

Furthermore, a questionnaire was used with 38 students after they played the LG *the Holy Torq*. The different factors explored in the questionnaire enabled to collect students' experience regarding the following aspects of the product dimension: balance of difficulty (through the challenge factor in the questionnaire), clarity of goals (through the goal clarity factor), clarity and constancy of feedback (through the feedback factor), easiness of use (through the autonomy factor), immersion (through the immersion factor). The results of the questionnaire are available in Annex 8.3.5. Table 22 and Figure 30 illustrate the results of the questionnaire per factor.

Factors	Mean	SD	Median	Mode	Variance	Minimal	Maximal
Goal clarity	4,67	0,62	5,00	5,00	0,38	3,50	5,00
Challenge	3,92	0,61	4,00	4,00	0,37	3,00	5,00
Feedback	3,94	0,92	4,17	5,00	0,85	2,67	5,00
Immersion	4,36	0,47	4,33	4,33	0,22	3,50	5,00
Autonomy	4,38	0,48	4,50	4,50	0,23	3,50	5,00
Innovation	2,96	1,14	2,75	2,00	1,29	1,00	4,50

Table 22: Results of students' questionnaires per factor (product dimension) - Case 3 (*n* = 38)

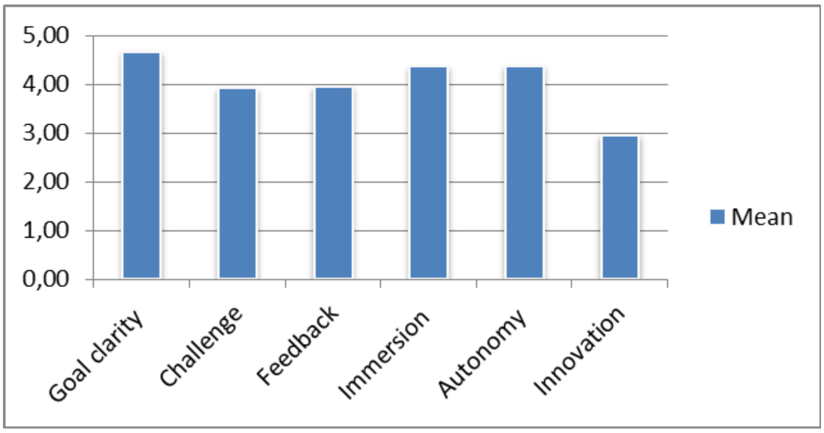

Figure 30: Results of students' questionnaires - Means per factor (product dimension) - Case 3 (*n*=38)

3.2.1. Usefulness (1USE)

a) Gaming aspects (2GA)

Clarity of goals (3GOALS)

To both experts and teachers, the story of the game is clear and correctly informs the player of what he has to do. As expressed by Expert 2, "I know the story very good, I know I have to find three objects, and I am guided" (Annex 8.3.2a). Nevertheless, the expert argued that intermediary goals are not obvious when the player does not act in the expected manner: "if I speak with who I have to speak, in the right order, I perfectly know what I have to do, and what the story is about. If not, there are no characters to guide me or to ask me: 'did your talk to this guy?'" (Annex 8.3.2a).

The results of the questionnaires showed that students correctly understood the objectives of the LG (M = 4.67, SD = 0.62). They strongly agreed on saying that they clearly understood the game instructions (M = 4.83, SD = 0.39), and that they knew what they had to do and to achieve (M = 4.50, SD = 1.00).

Balance of difficulty (3DIFF)

Teachers considered the level of difficulty adapted to students' profile, and balanced along the game. However, experts do not agree on this point. To Expert 1, the game does not present any difficulty. Indeed, the player is guided all along the game, and can neither be wrong nor lose the game: "it [the game] is so guided that if you don't do something, it indicates you how to do it. Thus, you can't lose" (Annex 8.3.2a). For example, when the protagonist has to search for the book, her friend immediately tells her where to find it, although the player did not ask for any help: "if I don't need help, it's not necessary that you help me. I'm enough autonomous to do it myself. More than an assistant, he is the one giving me the permission" (Annex 8.3.2a). Consequently, the expert considered the level of the game too easy for the age range it targets: "for 12 years old children, I find it too easy". In contrast, Expert 2 argued that the level of difficulty can be too high for students' profile, due to usability concerns: "not because the things that I have to do are difficult, but because of the right click, the functionality 'talk with', etc. I think you have to accompany them first, otherwise, they will get angry" (Annex 8.3.2b).

As shown by the results of the questionnaire, students considered the challenge of the LG to be adequate (M = 3.92, SD = 0.61). Indeed, they agreed that the game was challenging, but that they were able to solve it (M = 4.00, SD = 0.95). They also agreed on saying that the game was neither too easy nor too difficult (M = 3.75, SD = 1.22), and provided help in case of difficulty (M = 4.00, SD = 1.35).

Clarity and constancy of feedback (3FEED)

Teachers considered feedback elements clear enough to enable students to achieve the game without problems. In contrast, experts highlighted the lack of feedback elements. To Expert 2, feedback is neither clear nor constant along the game: "it lacks feedback elements, sometimes visual, sometimes auditory" (Annex 8.3.2b). In his words: "there is a problem of script, because sometimes I have to do things in a determinate order, otherwise, simply, I don't receive any answer, so I don't know whether I am doing it right or wrong" (Annex 8.3.2b). To him, "graphical adventures of 15 years ago told you when the order was not correct, or when you did something wrong" (Annex 8.3.2b). Expert 1 valued the presence of the inventory, which enables the player to see the objects collected. She suggested adding a map showing the structure of the fort in order to give players more visual information about their localization.

The feedback factor scored high (M = 3.94, SD = 0.92). Students agreed that they received the necessary feedback on their actions (M = 4.17, SD = 1.59), that the game correctly informed them on their success or failure (M = 3.67, SD = 1.44), as well as on their progress (M = 4.00, SD = 1.04).

Clarity and consistence of rules (3RULES)

To teachers, the rules are clear and consistent, although they considered the game "very guided", due to their difficulties to program complex actions and variables with the eAdventure editor.

Experts considered the system of rules generally simple. Expert 2 argued that rules are clear and consistent along the game: "either you walk, or you talk, or you take" (Annex 8.3.2b). However, as mentioned by both experts, some functionalities are not consistent and can confuse the player. In the words of Expert 1, "the two options of the game (…), 'examine' and 'take', are confusing. And they are not used in a consistent way for each action".

Immersion (3IMMER)

Teachers and experts expressed different opinions regarding the potential of immersion offered by the LG. Experts stated that the game topic, i.e. ancient worlds with wizards, druids, swords, trees and Galicia, match the interests of students from the targeted age range. As expressed by Expert 1, "the thematic is great for them" (Annex 8.3.2a). Furthermore, she positively valued the fact that the protagonist is a girl, which can help girls connect with the thematic.

She also liked the humoristic elements included in dialogues. However, she argued that the story lacks some important elements which could enhance immersion: "usually, in a game, you have a role and a mission. Okay, but, why me? What is so special with me, so I have to go and save my friend? It would be interesting to tell players what is their role: who am I, I am a child from the village, where are the others, have they disappeared?" (Annex 8.3.2a). Expert 2 also argued that the sword has a strong potential of immersion. However, he was disappointed of not be able to use it: "I never used it, I wasn't scared, when the amazon appeared, I didn't use the sword to protect myself" (Annex 8.3.2b).

To Expert 1, the quality of the graphical environment is low for the targeted group: "aesthetically, it is good for being amateur, but 8 to12 years-old kids will say they don't like the drawings" (Annex 8.3.2a). Indeed, to her, children from this age range are used to see high quality graphics in current COTS. In her words, "this is the problem with serious games, budget is very low, and it's difficult, because you have some genius artists, but you don't have money to pay for quality of such artists" (Annex 8.3.2a). As for Expert 2, he considered the audio-visual environment scarce: "with 8 years, they are impatient, thus, the fact that the screen is quiet, and nothing is happening, there are no signals, music, a little bird which… I don't know. They come from interactive books, in which you can touch everything, everything moves. I think there is a problem with the static aspect" (Annex 8.3.2b). In contrast, teachers argued that their students positively valued the audio-visual environment of the game, and were happy to hear their voices. In the words of Teacher 3, "I think they liked it a lot. They could identify themselves to the characters" (Annex 8.3.3b). Both experts also liked to hear children's voices. To Expert 2, "what I preferred was the language, listening to Galician, the passion of children, their tone. And listening to the sweet voices of children" (Annex 8.3.2b). However, both experts mentioned that the game lacks music themes related to the content. As expressed by Expert 2, "When I watch Braveheart, to get this epic feeling, I need a soundtrack behind" (Annex 8.3.2b).

To Expert 2, the interaction system (i.e. consisting of walking characters, taking objects, etc.) matches the targeted age range. Nevertheless, he suggested that some interactions could be added in order to enhance students' engagement, such as jumping in order to reach items, searching for hidden objects, and looking for the adequate movement to reach something.

Finally, both experts outlined the lack of freedom given to the player, who is "obliged to do things in a certain way" (Annex 8.3.2b). Indeed, as they discovered the game, they experienced a sensation of freedom, and then got "frustrated to not have it" (Annex 8.3.2b). In the words of Expert 1: "I would like to see some paths in which you can get lost, and to have, in this sense, more emotion" (Annex 8.3.2a).

Students' opinions on immersion appeared to be positive (M = 4.36, SD = 0.47). Indeed, they agreed on saying that they felt involved with the game (M = 4.00, SD = 1.41), that time passed quickly as they were playing (M = 4.08, SD = 1.56), and that they could forgot about their surroundings (M = 3.92, SD = 1.31). Furthermore, students strongly agreed on saying that they enjoyed playing and would like to play more (M = 4.92, SD = 0.29), and that they did not care about wining, as they were having a great time by only playing (M = 4.83, SD = 0.39).

b) Pedagogical aspects (2PA)

Clarity of pedagogical objectives (3PO)

To experts and teachers, the pedagogical objectives and competences are clearly defined in the GBL scenario.

Connection to the curriculum (3CURRI)

To experts, the game is adapted to primary education curriculum. Furthermore, teachers argued that the game contents match the curriculum objectives. Teacher 3 asserted that the game has the potential to introduce content related to many different fields, which the curriculum sometimes does not cover.

Alignment of game play and pedagogical objectives (3ALIGN)

The objectives addressed in the scenario are included in the game. Indeed, the elements of knowledge teachers planned to introduce are "integrated in the narrative of the game" (Annex 8.3.2a). In order to solve the game, players have to interact with elements that teach them about Galician ancient culture, the vocabulary, objects and elements related to the historical period at stake (e.g. huts, forts, druids, local trees, clothes). Nevertheless, experts argued that the game should provide more descriptive details about these elements. Furthermore, Expert 1 stressed that some objectives (e.g. taking care of the environment) are only partially represented in the game: "to get familiar with the life in forts… The story seems more fictional. I don't know whether the loss of a torq is part of daily life, of how they worked, they ate and communicated" (Annex 8.3.2a).

Appropriateness to the profile of the profile of students (3APPRO)

To teachers, pedagogical objectives are adequate for students' profile. However, Expert 1 stated that the age range targeted in the GBL scenario is very wide, and that the game cannot match the level of all students: "the book, for example, is closer to a child of 5th or 6th, than to a child of 3rd. In contrast, the game dynamics, for a child of 3rd, are good because they are lineal. But it can seem completely useless for the others" (Annex 8.3.2a).

Planning of complementary activities (3ACTI)

To experts, the GBL scenario presents a good variety of complementary activities, such as discussion sessions and visits of museums. They suggested adding more interactive activities. For example, they proposed a "trivial pursuit" before the game, and transmedia activities after the game: "they could dress up as in the game, for example, and continue the narrative in other contexts, to reinforce the information" (Annex 8.3.2b). Expert 2 suggested adding collaborative aspects to the GBL scenario: "graphical adventures are good for playing in two. Because what one doesn't see, the other sees it, you fight, it's funny" (Annex 8.3.2b). Expert 1 suggested that the teacher should have more implication during the GBL session: "they could have a much more active role, evaluating, observing, promoting communication and exchange, sharing strategies" (Annex 8.3.2a).

Pedagogical evaluation (3EVAL)

Both experts noticed that the evaluation of students' knowledge is not included in the game. They suggested that the evaluation strategies planned in the GBL scenario should be extended and detailed. For example, Expert 1 proposed to complete the evaluation strategy through the role of the teacher during the GBL session: "it's interesting to observe the ambience of the classroom with a digital game. It gives you elements to evaluate and collect students' doubts" (Annex 8.3.2a).

Adequate use of documentation resources (3DOCU)

Experts stated that the game offers useful documentation resources. For example, the book provides content on local trees. However, to them, students will probably not read the book. In the words of Expert 2, "if you pretend that people learn through what is written, it's a problem. Because people will not read, unless you put them a gun on the head" (Annex 8.3.2a). Hence, they suggested adding different types of resources to the game, e.g. links to useful content available on the Internet.

Furthermore, both experts and teachers argued that more learning resources could be added to the game. For example, Expert 1 stressed that, "to discover what is a torq, I cannot use anything. The game doesn't give me any clue of what it is. It would be possible to integrate a picture that you could examine, the different types of druid. It could be extended" (Annex 8.3.2a). In addition, Teacher 3 stated that she would have liked to add more resources, which would enable students to discover more about forts, i.e. the way they were organized, the daily life, and what remains from them nowadays.

Planning of necessary resources (3RES)

Both experts considered that the use of the game did not require any complicated resources. In the words of Expert 2, "I'm sure it works from any computer, with a mouse, and can be launched offline. I mean, easier, impossible" (Annex 8.3.2b). Expert 1 only mentioned that sound can be problematic in some primary schools. Furthermore, the duration planned is adequate to the context of the classroom, as one session is sufficient in order to complete the game.

Attention to diversity (3DIV)

To experts, diversity is not taken into account in the LG. Indeed, the game does not include any adaptation of level according to students' age, and presents a predominance of masculine elements. Furthermore, it does not address usability issues related to students with psycho-pedagogical problems.

c) Usability aspects (2UA)

Easiness of use (3EAS)

To the experts, the game presents some important usability problems, such as the lack of tutorials, non-intuitive functionalities, inconsistencies, and "actions that go out by default" (Annex 8.3.2b). Hence, the player has to proceed by trial and error in order to find out how to use functionalities. Expert 2 argued that usability problems can, in this specific case, enhance students' engagement. In her words: "exits are sometimes difficult to find, but from the point of view of a kid, it can be fun to search for the exits" (Annex 8.3.2a).

Teachers, in contrast, mentioned that usability aspects are generally correct, except of some details that they could not fix. To them, their students easily managed to use the game.

Questionnaire results show that students did not meet any major difficulty regarding usability. Indeed, the autonomy factor scored high (M = 4.38, SD = 0.48). Students agreed that it was easy to manage the game (M = 4.42, SD = 0.67) and to learn how to use it (M = 4.33, SD = 0.78).

Minimizing of errors and dead points (3ERR)

Experts identified some dead points due to the editor's affordances, such as the *examine* option, which does not lead to any action. Furthermore, they outlined that the protagonist sometimes starts talking without making any sound.

Easiness of installation of the game (3INSTAL)

Both teachers and experts considered the game very easy and quick to install, as it does not require any complicated operation or material.

Compatibility (3COMPA)

Both experts valued the compatibility aspect correct.

Accessibility (3ACCES)

To experts, this aspect should be worked on, as the game does not address students with disabilities (e.g. with audition or vision problems). To them, the right click system can be complicated for some students, and the size of letters could be adaptable to students' special needs.

3.2.2. Novelty (1NOV)

a) Little-c creativity (2LCC)

Teachers (3TEACH)

Teacher 2 considered the game innovative regarding his usual practices: "maybe it seems new for me, but others already did it. To me, this kind of games, or activities, I hadn't seen much. What I had seen, at least visually, was less attractive. I think that our game resulted well and that it is new". In contrast, Teacher 3 had previously created a game for her students. Hence, she did not consider this game an innovative resource regarding what she created before. However, it was the first time she introduced new content to students from a game, and that she afterwards worked content on the basis of the game.

b) Middle-c creativity (2MCC)

Students (3STU)

Expert 2 stated the game is not innovative to students, as they know much more sophisticated resources, including augmented reality and touchscreen based games, in which children "do things with their little hands, and besides, they do it the way they imagine it should be done". To him, "we are talking about a graphical adventure of 25 years ago" (Annex 8.3.2b). In contrast, to Expert 1, it may be innovative for students, in the sense that this kind of resources is not widely used in schools.

Teacher 3 considered the game innovative in comparison to what students usually see in the school. She stated that some of her students are used to work with similar resources. However, "those who come from different schools, for them, yes, it was new" (Annex 8.3.3b).

Students' opinion was unclear regarding the innovative character of the LG (M = 2.96, SD = 1.14). They partially agreed on saying that this form of learning was innovative (M = 3.17, SD = 1.40), and that they were not used to conduct this type of activity in the school (M = 2.75, SD = 1.48).

Educational centre (3EC)

Teacher 2 considered the game an innovative teaching resource. In contrast, Teacher 3 stated that the game is not innovative regarding the resources that have been used in her institutions in the last years, in the context of the Ponte dos Brozos project.

c) Big-C creativity (2BCC)

Existing learning resources (3ELR)

Expert 2 considered the game an innovative educational resource, "up to certain extend" (Annex 8.3.2b). To him, the interactive book paradigm is already present in schools. However, he considered that introducing graphical adventure in the classroom is innovative in comparison with traditional teaching methods. He suggested using a graphical adventure with various chapters, to be played along the whole semester, as an innovative methodology.

To Expert 1, the game per se is not innovative, as many websites present resources with similar dynamics. However, it is innovative as this kind of resources is not widely used in schools. Furthermore, to her: "it's innovative that a teacher did it" (Annex 8.3.2a).

Existing games (3EG)

Both teachers and experts did not consider the game innovative regarding other games available on the market, which involve more sophisticated technologies, dynamics and interaction modes. However, they considered that the specific thematic of the game may bring innovative elements.

3.3. Teaching dimension

This section examines creative teaching and learning processes at stake as teachers applied their LG with students. First, it first looks at teachers' experience (i.e. the organization of the GBL activity, and their role during the game session), and then focuses on students (i.e. their level of engagement, and the achievement of pedagogical objectives). The analysis is mainly based on data collected with teachers' interviews (Annexes 8.3.3a and 8.3.3b). Additionally, it considers classroom observation (Annex 8.3.6) and students' questionnaire (Annex 8.3.5).

3.3.1. Teachers' experience (1TE)

a) Organization of the GBL activity (2ORG)

Teachers conducted complementary activities around the game session. Teacher 2 organized some preparatory activities, during which students searched for information and pictures about Galician forts, and discussed the topic in the classroom. Furthermore, they started to work on a web-based project related to the game topic, which they continued and finalized after the GBL session, according to the elements of knowledge found in the LG. This web-based project served to evaluate students' knowledge.

As for Teacher 3, she organized a pre-game activity, during which students observed and discovered local plants that were in the patio, and the way they were growing. She stated that these activities offered an introduction to the game. Nevertheless, she did not perform any activity to evaluate students' knowledge.

Teachers stated that the game session enabled them to give meaning to other activities and subjects, as well as to connect knowledge to the world outside the classroom. In the words of Teacher 2, "the game was done to bring them [students] closer to the world of History. But apart from that, it enabled us to bring them closer to nature, to know the trees that exist in Galicia, autochthon trees. And it enabled us to give a first step to introduce the activity of collecting information about trees that exist in the school" (Annex 8.3.3a). Furthermore, Teacher 3 argued that the game served as a basis for teaching different ages, disciplines and lines of work.

b) Role during the game session (2RGS)

The classroom observation (Annex 8.3.6) enabled to describe the organization of the game session conducted by Teacher 3. First, the teacher gave instructions to students in order to correctly use the game functionalities (i.e. to use, to take) and asked students to try them. He also encouraged them to interact and experiment with the different objects of the game. In his words, "to play is to try everything" (Annex 8.3.6). He told them to raise their hand in case of problems, and asked them to wear headphones. Students started to play the game individually. The game session lasted for 15 minutes. The classroom was generally quiet. During the game session, the teacher was walking, checking that everything went well.

Both teachers stated that their role in the classroom moved from an active, central role of organizer, who directs and gives indications, to a more passive role, consisting of helping students in case of needs, and encouraging them towards learning in an autonomous manner. To one of the teachers, this role was especially pleasant, as he could easily reach students' concentration and enjoyment.

3.3.2. Students' experience (1SE)

As for the other cases, students' gaming experience was explored through different aspects, i.e. immersion, concentration, autonomy, social interactions and achievement of the pedagogical objectives. I considered data collected through interviews with Teachers 2 and 3 (Annexes 8.3.3a and 8.3.3b). Furthermore, in order to corroborate findings, I looked at the classroom observation report (Annex 8.3.6) and at the results of students' questionnaire (Annex 8.3.5). Table 23 and Figure 31 illustrate the results of the questionnaire per factor.

FACTORS	MEAN	SD	MEDIAN	MODE	VARIANCE	MINIMAL	MAXIMAL
Autonomy	4,38	0,48	4,50	4,50	0,23	3,50	5,00
Concentration	4,29	0,72	4,25	5,00	0,52	3,00	5,00
Immersion	4,36	0,47	4,33	4,33	0,22	3,50	5,00
Social interactions	1,44	0,56	1,33	1,00	0,31	1,00	2,67
Knowledge improvement	4,62	0,38	4,60	5,00	0,14	4,00	5,00

Table 23: Results of students' questionnaires per factor (teaching dimension) - Case 3 (*n* = *38*)

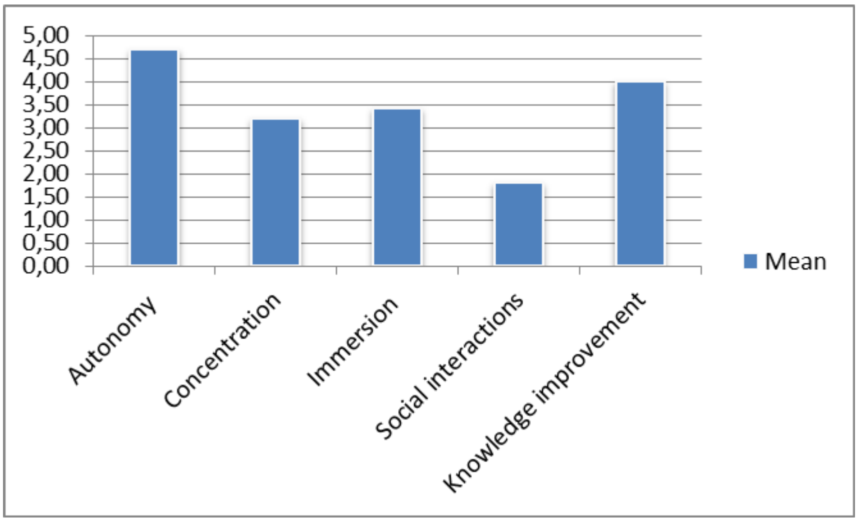

Figure 31: Results of students' questionnaires - Means per factor (teaching dimension) - Case 3 (*n*=38)

a) Engagement (2ENG)

Immersion (3IMM)

Teachers considered that their students were engaged and motivated while playing. Nevertheless, they argued that the context of the classroom prevented them from being totally absorbed in the game activity. As Teacher 3 puts it, "as they are in the classroom, they are attentive to anything that happens. Maybe if they were at home, or in a place in which they seat alone (…), they would be absorbed in the activity" (Annex 8.3.3b). Observations showed that all students centred their attention on the game task during the whole session. Conversations with the teacher or with other students were always related to the game. Furthermore, observations outlined many signs of positive engagement with the game, such as laughs and smiles on students' faces.

The results of the questionnaire regarding the immersion factor (see Section 3.2.1) showed that students felt involved with the game, enjoyed playing, and experienced time transformation. In contradiction with teachers' opinion, they stated that they could forget about their surroundings and focus on the game.

Concentration (3CONC)

Interviews and observations indicated that students remained concentrated on the game objectives during the whole session. They did not show any distraction, and focused their attention on the activity until they solved the game.

Regarding the results of the questionnaires, the concentration factor scored high (M = 4.29, SD = 0.72). Students strongly agreed on saying that that they were totally concentrated on the game (M = 4.67, SD = 0.65), and found it easy to not get distracted during the session (M = 3.92, SD = 1.38).

Autonomy (3AUTO)

Students quickly showed a high level of autonomy in managing the functionalities of the game. They intuitively accomplished the tasks without having to think on how to deal with the interface. They rarely required the support of their teachers. Nevertheless, they often collaborated in order to resolve difficulties related to usability issues (e.g. how to go out of a screen, which objects to touch). Results of the questionnaire confirmed that students felt autonomous using the game (M = 4.38, SD = 0.48), and that they found it easy to learn and to manage its functionalities.

Social interactions (3SI)

Teachers argued that students collaborated in order to solve the objectives of the LG. Indeed, they spontaneously helped at each other's when they met difficulties related to the game functionalities, or to reach the game objectives. As expressed by Teacher 2, "usually, with books, they help each other's, but in this case, as it is more playful, there was more collaboration than other times" (Annex 8.3.3a).

Observations also outlined social interactions among students, such as laughter and smiles, and work out strategies, in which students pointed at their classmates' screen to show them how to solve some aspects.

Nevertheless, social interactions scored low in comparison to the other factors (M = 1.44, SD = 0.56). Students did not agree on saying that they talked to their classmates (M = 1.33, SD = 0.49), solved some of the goals of the game with the support of their teacher (M = 1.25, SD = 0.62) and classmates (M = 1.75, SD = 0.87).

b) Achievement of the pedagogical objectives (2APO)

Teachers argued that students could achieve the pedagogical objectives addressed in the LG. Furthermore, they stated that playing the game enabled students to develop flexible and multiple perspectives on some knowledge elements. Indeed, students could relate the game to their previous knowledge about their city.

The knowledge improvement factor scored very high (M = 4.62, SD = 0.38). Students agreed that they could both apply knowledge they learnt in class (M = 4.42, SD = 0.90) and acquire new elements of knowledge (M = 4.75, SD = 0.62). Furthermore, they argued having perfectly understood what the game wanted to teach them (M = 4.58, SD = 0.51). They strongly agreed that the game motivated them to learn (M = 4.75, SD = 0.45) and that they want to know more about the topic taught in the game (M = 4.58, SD = 0.67).

3.4. Teachers' perspectives on creative pedagogies

To teacher 3, a creative teacher "is in contact with his students, and they go with him, and they walk together toward the same direction" (annex 8.3.3.b). She argued that the research approach allowed for the application of this definition.

4. Case study 4: design and application of the LG Masked Vinyl

This section analyses the design and application of the LG *Masked Vinyl* (Annexes 4.4.1) by the teacher from Case 4.

4.1. Process dimension

As for the other cases, this section analyses the different stages of the game design process. It takes into account data collected with the teacher's interview (Annex 8.4.1), teachers' questionnaire results (Annex 8.1.4), and game design documentation (Annex 8.1.5).

4.1.1. Game design stages (1GDS)

a) Stage 1: task identification (2TI)

Engagement in the task (3ET)

The teacher shows a special interest in GBL methodologies, and is always researching for related initiatives. When he found out about the possibility of creating in own LG, he decided to participate in the research.

Both intrinsic and extrinsic types of motivation stimulated him in undertaking the task. First of all, as a gamer, he is personally interested in digital games. He was motivated by the fact of designing a complex game and discovering a new editor tool. In his words, "I had never worked with this type of editor, and I had never developed a complex game. I had created simple game-like applications, which were very nice visually, and the creation process was relatively easy. But with this one, I saw a complex environment, and it motivated me. You have many options for creating, editing scenes yourself with pictures, characters; it is already a complex process" (Annex 8.4.1).

Second, the teacher considered games a powerful educational methodology. To him, "it's an activity which really fosters the development of skills" (Annex 8.4.1). Furthermore, he argued that digital games are part of students' culture. In his words: "digital natives do not need to make any effort to understand games' mechanics (…). This is a reason for incorporating gaming structures into education" (Annex 8.4.5).

Definition of the pedagogical objectives (3DPO)

The teacher first had the intention to work on a topic which was, to him, interesting and popular at this time, i.e. the Arabic spring. In his words, "it was a topic which was in the public opinion, and I was interested in it". Nevertheless, he realized that the subject was too complex and that he could not address it comprehensively with the resources he had: "I started to work with four or five elements in the design, to write the objectives of the game, the key-elements, and so many things came out that I left it for impossible. It can be done, but I think you need a work team to realize a complex game" (Annex 8.4.1).

Hence, the teacher chose to work on a domain "which [he] could access without having to research too much" (Annex 8.4.1). He chose modern music, a field in which he had a high level of knowledge. Furthermore, he showed a high interest in the topic of Rock music, and considered it to be innovative and original. Furthermore, he mentioned that the game design process coincided with the inauguration of the first museum of Rock music in Europe in Barcelona. This motivated him in planning further activities, such as the visit of the museum with students (Annex 8.4.5). As a result, the definitive topic for his game was the history of Rock music.

b) Stage 2: preparation (2PRE)

Domain-relevant skills (3DRS)

In order to design his LG, the teacher considered having developed various kinds of domain-relevant skills:

- *Game design principles:* he considered necessary to be acquainted with digital games' narrative and dynamic elements.
- *Technical skills:* he mentioned various types of technical skills as necessary to achieve a working game, i.e. programming, the management of the editor's functionalities, and the edition of sound and picture files.
- *Integration of pedagogical content:* finally, he considered important to know how to link educational resources with game dynamics.

Learning process (3LP)

The teacher stated that he mainly acquired game mechanics and dynamics through practice, i.e. by playing various games. In his words, "when you play various digital games, it gives you the intuition to do it. When you are a user of educational activities and websites, you understand these dynamics" (Annex 8.4.1).

Besides of learning how to use the editor during the training workshop, he had to practice, through a self-regulated process, in order to manage its different functionalities. In his words, "game editors, as any digital application, cannot be acquired through an intensive explanation provided through a course; rather, it can be learnt through practice and through mistakes" (Annex 8.4.1). To him, programming skills were the most difficult to acquire.

Finally, the teacher stated that he did not focus his attention on learning how to integrate pedagogical content. Indeed, he considered this aspect assumed, and preferred to centre on learning how to develop game dynamics.

c) Stage 3: response generation (2RG)

Conceptualization (3CONC)

The teacher mentioned that, at the beginning of the process, he "wanted to do very complex things" (Annex 8.4.1). As he started to elaborate his idea around the Arabic spring, he decided to discard it, and to develop ideas which were easier to concretize. The initial conceptualization process took into account the following parameters:

- *Feasibility:* the teacher chose a simple idea that he could realize by himself, without needing to research new content.
- *Domain-relevant skills:* he chose to design a game related to a domain he was expert in, i.e. Rock music. Hence, he did not need to learn any complementary element in this field to complete the game, and could concentrate on game mechanics.
- *Originality:* he chose an idea which would enable to create an innovative LG.
- *Personal interests:* the idea was selected as it naturally attracted the teacher.
- *Teaching opportunities:* he considered that the idea would bring interesting educational possibilities.

Once he considered it definitive, the teacher maintained his idea all along the design process. He only adjusted the interactions modes between the player and the interface, and extended the game with new scenes and content.

Elaboration (3ELAB)

The teacher elaborated the educational content and the elements of his LG in a detailed storyboard (Annex 8.4.5). The document included the objectives of the game, a general description of its rules and dynamics, as well as the contents of the scenes. Furthermore, it detailed the list of the artists presented in the game, together with the places, the objects players would have to interact with, and the songs they would listen to.

The teacher did not concentrate on the elaboration of contents and pedagogical strategies. As he mastered the domain, this process was rather unconscious. He preferred to concentrate on the design of the dynamics and interactions of the LG. Game dynamics were designed as the teacher was trying out possibilities on the game editor: "I was remembering actions that I saw in games as a player, and I was trying to do it with the editor: is it possible to do it, or not?" (Annex 8.4.1).

The teacher considered the elaboration process to be him laborious and time-consuming. In his words, "when we have a game design tool, we think, 'okay, now I can create a game'. But this process is a second part of 50%, the first 50% consisting of the planning and production processes. So it's like creating a movie or a short film (…). From the starting point, to the point at which you have the camera in the hands, there is a very long process. In a game, it is the same" (Annex 8.4.1).

Production (3PROD)

The teacher produced all his graphical resources. This process was the part of the design process he most enjoyed. It consisted of selecting pictures from the Internet and editing them in order to create "the fantastic environments of each musician that the player has to discover" (Annex 8.4.1). To him, it was not difficult, but time-consuming: "at the end, design is hours, to edit images, link them together, I mean, it's an inversion of time" (Annex 8.4.1).

The teacher described programming as "the most difficult aspect" of the design process (Annex 8.4.1). Indeed, he pointed out that programming consisted of a discovery process, during which one tries, selects or discards solutions, through many cycles of trial and error. Hence, programming required an important inversion of time, learning, concentration and efforts in order to correctly link actions and to obtain the expected answer.

The teacher argued that the editor is not user friendly. To him, all environments from this type are little intuitive, and functionalities are difficult to remember. In his words, "some interactions with the editor were frustrating and difficult to understand"; "it's not like riding a bike (…). In this case, when you don't touch the software during a month and then you come back, the first day you need to learn again what you learnt before" (Annex 8.4.1). In addition, the teacher sometimes encountered difficulties while using some functions, such as the integration of sound and video elements. In his words, "here is the weakest point of the editor, the topic of videos. It's complex, complicated, and the quality of the video is very tight, due to problems of weight and desynchronization" (Annex 8.4.1).

In spite of usability concerns, the teacher considered the editor powerful, as it offers a wide range of functionalities. Furthermore, he described it as innovative, as it enables to create original games based on graphical adventures. He also considered eAdventure an excellent tool to introduce beginners to programing: "it is, per se, a tool for learning how to program. You don't program, but you acquire programing skills" (Annex 8.4.1). The teacher argued that the editor facilitated the emergence of ideas. In his words: "as you play with the editor, you discover that this action that you had in mind is only a little part of what is possible to do. First, you have to learn how to work with easy, solid steps. Once you have acquired these solid steps, you discover that, aside those steps, there are others which enable to realize more actions. That is why I can say that it [the editor] activates creativity" (Annex 8.4.1).

d) Stage 4: response validation (2RV)

As he was progressing in the design process, the teacher constantly evaluated and adapted the elements of his game. The following paragraphs describe these validation cycles.

Response validation criteria (3RVC)

The game evolved as the teacher was discovering the editor's functionalities and evaluating different solutions: "you start using the editor with very basic ideas. As you advance, you discover secrets of the editor, about its functionalities. As you work, you discover new functionalities that you try and select for the game, or discard" (Annex 8.4.1).

As mentioned earlier, the teacher adapted his initial idea in order to be feasible to develop. Furthermore, he had to discard many other ideas because of time constraints. In his words, "I thought I could do the game in less time. Thus, I had to adjust my game and objectives according to the time implied by the design tasks" (Annex 8.4.4.). For example, his intention was to integrate a character the player could speak to: "this was my idea, but, at the end, I renounced, for difficulty and time" (Annex 8.4.1).

The teacher resumed the response validation stage in the following manner: "I adjusted my strategies and ideas all along the development process, according to the constraints implied by the editor, the time, and my skills to manage the editor" (Annex 8.4.4).

Response validation strategies (3RVS)

The teacher evaluated and adjusted his game through an iterative process, employing the following methods:

- *Self-testing with the editor:* he constantly tested his game and adjusted its interactions through the editor, through a trial and error process. As he identified problems or possibilities for improvements, he adapted the elements until achieving a workable version.
- *Online support:* the teacher sometimes requested support to the researcher in order to ask for feedback regarding the game's interaction system.
- *Peer review:* in rare occasions, he showed his LG to a few persons (i.e. his family members) in order to obtain external opinions on how to make interactions clearer and to improve aesthetic aspects.

e) Stage 5: outcome (2OUT)

The time available for the design process did not enable the teacher to finalize his LG. Nevertheless, the paragraphs below highlight his perceptions on the outcome (i.e. an advanced demo of the game), and the way he spread it among the community.

Outcome evaluation (3OE)

The teacher was satisfied with the outcome of the design process. He stated that he did not reach his objective (i.e. the achievement of a final version of the game), but progressed towards it. He aimed to finalize it, by creating more interactions, improving the graphical environment and completing content. He argued that the result is close to what he imagined, and that the visual design is much better that he expected. The teacher considered the task to be highly challenging, and was strongly involved with his game, in which he invested many hours and efforts.

The design process was a challenging experience for the teacher. Indeed, he designed his own graphical resources, as well as all the game interactions, with an editor which was totally new for him. As a result, he is satisfied and proud of the result obtained.

Communication (3COMM)

As the game has not been finalized, the teacher has not applied it with his students. Nevertheless, he diffused his project among the educational community. For example, the Rock museum of Barcelona contacted him, in order to negotiate an eventual contract to finance the development of a new version of the game and its exhibition in the museum.

4.1.2. Collaborative game design (1CGD)

In contrast with the other cases, the teacher decided to conduct the game design activities in an individual manner. In consequence, he had to adopt a variety of roles during the design process. He first adopted the roles of game designer and scriptwriter. Afterwards, he became a graphical designer, selecting and editing pictures to best reflect the artist's environments. Lastly, he converted to a programmer. In parallel to these different roles, he argued that he combined the ones of expert in the knowledge domain and educationalist. To the teacher, some roles were more predominant than others. For example, he brought a minor focus to the role of educationalist: "I suppose it was there behind" (Annex 8.4.1). In contrast, the role of programmer was "the most costly" (Annex 8.4.1).

The teacher asserted that his LG would have been different if he would have worked in a collaborative manner: "I would have generated a highest number of ideas, and maybe more valid ideas" (Annex 8.4.1). He stated that he would have liked to involve a scriptwriter and a dialogue writer in the design process, as he lacks expertise in these domains. To him, working in a team can benefit the design outcome, at the condition that group members share the same interest.

In contrast with the other cases, the teacher acted independently of his educational community. Although his colleagues and managers encouraged him through his project, they did not get involved in the design process. He showed his game to his colleagues, and stressed that only technologists showed interest in the methodology: "many of them saw the software and got scared" (Annex 8.4.1). In addition, he preferred to not involve students in the design process: "it did not seem a good idea to involve them in this type of game, basically because of their ignorance regarding the discipline" (Annex 8.4.1). However, he took them into account during the whole design process: "in every moment, I thought this game for students of second year of upper education" (Annex 8.4.1).

4.2. Product dimension

This section looks at the LG *Masked Vinyl* and the corresponding GBL scenario (Annexes 4.4.1 and 4.4.2) according to different criteria, namely gaming aspects, pedagogical aspects, usability and innovation. The analysis is based on data collected through the interviews performed with an expert in the field of GBL (Annex 8.4.2) and with the teacher (Annex 8.4.3). In contrast with the other cases, the LG was not tested with students. Hence, data do not include questionnaires results.

4.2.1. Usefulness (1USE)

a) Gaming aspects (2GA)

Clarity of goals (3GOALS)

To the expert, the game provides explicit clues which make the intermediary and final goals clear for the player. In his words, "clues are very explicit, because each time I bring the cursor on an item, it gives me hints of whether I have to take it or not" (Annex 8.4.2).

To the teacher, the game correctly informs the player about the goal of the game, i.e. search for objects which are compatible, and which pertain to the corresponding artist, in order to reach the following scene. However, he stated that the current version of the game has no final objective.

Hence, the game is composed of small objectives related to an artist and his environment (Annex 8.4.3).

Balance of difficulty (3DIFF)

The teacher considered the level of difficulty adequate, as players have to link their knowledge to the right action (Annex 8.4.3). In contrast, to the expert, the game is too easy and "too obvious" for the level of the targeted audience. To him, challenge is related to usability problems, rather than to the difficulty of the game objectives. Indeed, the clues given to the player can make the game too easy to solve. Furthermore, he argued that once the first enigma is solved, the rest of the game is repetitive and easy, as students have understood its way of working (Annex 8.4.2).

Clarity and constancy of feedback (3FEED)

The teacher argued that all the game objects and actions lead to reactions (Annex 8.4.3). In contrast, to the expert, the feedback system could be improved. He asserted that all feedback elements should include both visual and audible indicators. For example, he stated that some objects should be highlighted when the player moves the mouse over them, as no feedback is provided until the players interacts with them. Furthermore, he outlined that feedback sometimes appears more than two seconds after the action (Annex 8.4.2).

Clarity and consistence of rules (3RULES)

To the teacher, rules are clear and consistent along the game. However, he mentioned that initial instructions would help players understanding the rules better. The expert, in contrast, outlined some inconsistencies regarding the game rules: "sometimes, it is not clear whether we should drag and drop, take, or use" (Annex 8.4.2). Furthermore, the same icon is used for different verbs, thus losing it reliability as an information source.

Immersion (3IMMER)

To the expert, the game presents an attractive environment: "within the amateur, it's psychedelic, it's really cool" (Annex 8.4.2). Nevertheless, he argued that, as all games created with eAdventure or Scratch editors, aesthetics are not professional. The teacher argued that he is proud of the graphical environment he created for his game.

The expert outlined the presence of many elements which make the game experience dynamic: "now I see a video, now I listen to music, it's less lineal, less boring" (Annex 8.4.2). He argued that these elements do not distract players from the game objectives. Rather, they contribute to immersing them in the music environment. The teacher agreed on this point: "I think that the graphical elements I used were relevant, and sounds too. Because the elements that sound, when you are playing a Telecasta guitar and you click the button, what you hear is really a Telecasta guitar" (Annex 8.4.3). Furthermore, he described the narrative as simple and original.

In addition, the expert argued that the game contains rewards which can motivate students. Indeed, "the content itself is a reward, because the video is a prize, and listening to music is a prize" (Annex

8.4.2). Nevertheless, he mentioned that more rewards could be included to foster players' motivation: "there is no score, ranking, contest or prizes" (Annex 8.4.2).

Finally, the expert stated that game dynamics can enhance fun, as they relate to connect things together, and provide a high level of freedom to the player, who can explore and interact with the different elements present in the scene.

In contrast, both the teacher and the expert outlined, as a negative aspect, the repetition of the same dynamics, as well as the linearity of the script. As mentioned by the expert, it makes the game only playable once, as the player would not want to repeat the same scenes in the same order more than once.

b) Pedagogical aspects (2PA)

Clarity of pedagogical objectives (3PO)

To both respondents, the educational objectives are clearly explained in the scenario, and can easily be achieved by playing the game. In the words of the expert, "I learnt some things I didn't know. So it's somehow useful. Now, I still remember that Bob Dylan painted, and that Johnny Cash went to jail. I mean, I learnt some things. I could see videos, I listened to music. If I don't know the author, it's interesting" (Annex 8.4.2).

Connection to the curriculum (3CURRI)

Both the expert and the teacher considered the game adapted to the curricular objectives of the music discipline. They also argued that the curriculum in arts is characterized by flexible educational objectives and contents, which makes it easy to match the game content with the discipline.

Alignment of game play and pedagogical objectives (3ALIGN)

The level of integration of game objectives with pedagogical objectives is considered to be very high. As mentioned by the expert, "all what happens in the game is related to rock. You see a poster, you read a magazine, you listen to music, they show you the cover of an album, everything is super explicit. You are in an adventure in a different world, everything is rock" (Annex 8.4.3). Furthermore, rewards are related to listen to music, and the player has to play instruments in order to win them.

To the expert, the game promotes learning processes based on experimentation and discovery strategies: "I spent the whole game experimenting and discovering the different tools, which ones were useful and which were not. Thus, the game and the actions were associated with my skills to experiment with the tools" (Annex 8.4.2).

Appropriateness to the profile of students (3APPRO)

The expert and the teacher asserted that the pedagogical objectives are adequate for the target audience. Furthermore, knowledge is represented through textual, video, graphical elements which are adapted to students' profile. Furthermore, music elements are considered interesting and attractive for them.

Planning of complementary activities (3ACTI)

The teacher planned, in his GBL scenario, some activities around the game, such as a lesson in which students would express their music preferences and learn about the artists, and a visit of the museum of Rock music of Barcelona. Furthermore, he suggested that students research complementary information on the Internet after the game and continue completing the game, by adding new scenes and artists with the editor.

The expert considered these activities varied and interesting. He suggested taking the activities further. To do so, he proposed creating a gamified system through which students could compete in order to continue the game. They could win badges, earn points and be ranked according to their contributions.

Pedagogical evaluation (4EVAL)

The game does not integrate any evaluation system. However, the GBL scenario includes some activities (i.e. the development of extra scenes which would complete the game) which allow for the informal assessment of students' knowledge. Although informal assessment does not enable to know if students memorized the contents included in the game, the expert considered it relevant for the pedagogical objectives, i.e. to open students to musical culture. In the teacher's words, "music, in secondary education, is a discipline in which everyone learns, I mean, it's a game of informal learning" (Annex 8.4.3).

Adequate use of documentation resources (3DOCU)

To the expert, the game provides sufficient information about the artists through different media, i.e. the texts, the songs and the videos: "an interesting variety of content". However, it does not include any complementary access to other resources, which would enable students to go further in their learning process.

Planning of necessary resources (3RES)

To the expert, the game is completely feasible to apply in its context of use. Indeed, it can be launched from any computer, offline or online, and works with a mouse. Furthermore, he considered it feasible regarding the duration of the playing session.

In contrast, to the teacher, duration can be an issue, as students only have access to the computer 45 minutes a week. However, he stated that the present version can be used within this time slot.

Attention to diversity (4DIV)

To the expert, this issue is not addressed in the game. Furthermore, usability problems should be solved in order to avoid diversity issues.

c) Usability aspects (2UA)

Easiness of use (3EAS)

To the expert, the game presents serious usability problems. To him, it should include tutorials. Furthermore, functionalities are not intuitive and are difficult to memorize. In his words: "I didn't memorize them, because they didn't make sense to me"; "I learnt it at a mechanical level. But in one week, I will not remember" (Annex 8.4.2). In contrast, to the teacher, the game becomes easy to use once players have solved the first screen and learnt how to use the main functionalities.

The expert highlighted various inconsistencies. For example, some icons refer to various actions, which forces players to click twice in order to execute one action. He also outlined that it is not possible to do more than one thing in parallel: "you had to listen to a song, and until it was finished, you couldn't click on another object" (Annex 8.4.2).

As a result, the difficulty of the game is related to the problems of usability. The expert stressed that these problems are critical for the context of use of the game, as students from the targeted age range are the less tolerant towards usability concerns. He mentioned that, in most cases, the usability issues are due to the characteristics of the software.

Minimizing of errors and dead points (3ERR)

The expert outlined various programing errors, such as actions which come by default and do not work, inconsistent behaviours (e.g. a guitar's size increases and decreases without any reason), and the examine option, which does not lead to any action. Furthermore, he added that many actions do not include reactions, e.g. when the player does not take the right object, he should receive a corresponding feedback.

Easiness of installation of the game (3INSTAL)

Both the teacher and the expert argued that the game is very easy to install, and does not require any complicated procedure or material.

Compatibility (3COMPA)

The expert considered the compatibility aspect perfectly adequate to the context of use of the game. He positively valued that the game has a SCORM standard, as Moodle is used in all educational centres.

Accessibility (3ACCES)

The expert mentioned that this aspect should be worked on in details, as many situations (i.e. students with different types of disabilities) can be encountered.

4.2.2. Novelty (1NOV)

a) Little-c creativity (2LCC)

Teachers (3TEACH)

The teacher habitually integrates interactive and audio-visual materials in his teaching methodologies. Furthermore, he had previously used GBL approaches in his pedagogical practices, and created simple game-like applications. Nevertheless, it was the first that he designed a complex LG, including his own narrative, graphical resources and game dynamics.

b) Middle-c creativity (3MCC)

Students (3STU)

To the expert, the type of targeted students are used to play much more sophisticated games and systems, based on augmented reality, touch screens and voice orders. Hence, to him, the technology used needs to be improved in order to present an innovative character. However, he positively valued the innovative potential of the narrative and the graphical content. The teacher also asserted that his game presents an innovative plot and original contents for his students.

Educational centre (3EC)

The teacher argued that his LG is innovative regarding the resources used in his centre. To him, the pedagogical materials habitually used in schools are based on behaviourist strategies. In contrast, he considered that his LG opens a window to exploratory learning processes. To him, this type of strategies is innovative in comparison to the ones usually employed in the educational centres.

c) Big-C creativity (3BCC)

Existing learning resources (3ELR)

Both the expert and the teacher argued that the educational market contains many resources which are more innovative than the game. Indeed, interactive resources are widely used in today's classrooms. Nevertheless, the teacher asserted that his LG can be included in the range of products which aim to connect with digital natives in order to promote natural learning processes. In addition, the expert considered the game innovative, at the condition to solve the usability problems, and to relate each scene to a lesson, so to obtain a whole course based on the game.

Existing games (3EG)

Both the expert and the teacher mentioned that the LG is not innovative in comparison to other existing games, which involve sophisticated technologies. Regarding graphical adventures, the teacher stated that, "since the year 1980, the idea has been seen" (Annex 8.4.3). However, he argued that the objective of the experience was not to design a sophisticated and competitive game.

4.4. Teacher's perspectives on creative pedagogies

To the teacher, a creative process involves the creation of something new, in this case, the use of the videogame in education. It enables to see things from a different point of view. In these aspects, the GBL design process was creative: "I thought that doing games was reserved to professionals in informatics"; "Although the result is modest aesthetically, the process is still creative".

The teacher argued that the design process was creative, as he learnt how to use a new tool, and got the opportunity to familiarize again with the language of graphical adventures. Furthermore, for the first time, he could create a working videogame on a specific topic that he chose and that made sense in his teaching practices. Thus, he was offered a chance to develop a meaningful project which he is still continuing, and felt recognized for experimenting his creativity.

5. Synthesis: specificities of the cases

To close this chapter, the present section outlines the particularities of each of the four cases (i.e. their practices during the design and application of their LGs, as well as the specificities of their games), on the basis of the analysis above described.

5.1. Case 1

Teachers from Case 1 did not have any previous significant experience with GBL methodologies. They chose to work in a collaborative manner. Although they had not conducted any previous common project together, they quickly built trustful relationships, by working intensively in a synergic, flexible manner. They could make the best of their different profiles to overcome obstacles and make their way towards their common objective. Hence, their collaboration appeared to be an important factor for the success of their project. It resulted in the consolidation of a permanent team, ready to launch further innovative educational projects. In addition, teachers have been involving different actors from their social environment all along the design process, including students, colleagues, the educational centre, and local cultural and civic institutions. At the end of the design process, the team widely diffused its LG in local and national institutions. This opened them some doors for opportunities to take their project further.

Teachers dedicated a lot of efforts for developing valid, in-depth educational content, in order to reach a complete game related to a broad domain, and reaching various areas of knowledge. Hence, the game design process involved an important part of inquiry, through which teachers researched the environment reflected in their game. Educational contents and objectives evolved all along the design process.

Consequently, the main strong point of the LG consists of the high level of details of the educational contents. The documentation, as the graphical environment, bring a high amount of information in relation to the area of knowledge. Furthermore, the narrative is rich, imaginative, and includes a wide range of characters and representative objects. In contrast, teachers brought less attention to the game dynamics. As a result, the LG constitutes a question-answer quiz, and was considered to be linear and repetitive.

5.2. Case 2

As for Case 1, teachers did not have previous experience with GBL methodologies. They decided to work together, as they had collaborated in the past. They also built their LG according to an informal, spontaneous and successful collaborative design process.

At the difference of the other cases, teachers aimed to design a game in an autonomous manner, only using resources available to them, and not asking for any support. Hence, the outcome is more amateur, and consists of non-professional pictures. The strength of the LG is precisely related to the fact that the graphical elements are based on resources which are part of students' environments. This strength can also be considered as a weakness, as the LG does not include any element of fantasy or narrative.

In addition, teachers worked on the basis of clear and synthetic pedagogical objectives and elements of knowledge, which remained stable along the different design stages. Hence, the result consists of a simple and efficient game, allowing for the achievement of clear pedagogical objectives.

5.3. Case 3

The team of teachers from Case 3 had no previous significant experience with GBL. Teachers followed a path which is similar to Case 1. They worked collaboratively towards an interdisciplinary LG related the history of the Galician region. Furthermore, teamwork and the involvement of their social environment appeared as key factors for the success of their project. Interestingly, teachers used the game design process as a learning activity, in which students with hearing problems recorded the voices of characters, thus practicing elocution skills and developing their self-esteem.

The team dedicated a high amount of efforts on the elaboration of contents, audio-visual resources and narrative elements. As a result, the LG presents an important immersive potential, as the audio-visual resources includes many details of the environment it aims to reflect. The weakness of the LG is related to the lack of freedom provided to the player.

5.4. Case 4

Case 4 stands out from the other cases. Indeed, the teacher worked individually, and his profile is slightly different: he has a lot of experience with games and GBL methodologies. Furthermore, he has a high level of ICT skills. He did not involve any actor from his social environment in the design process. Rather, he worked as a lone creator, intrinsically motivated by the design activity itself, by creating a game on a topic he is personally interested in, and by learning how to use a new game editor.

Hence, the teacher naturally dedicated more importance to game dynamics, than to the pedagogical impact of his LG. As a result, the strong aspects of his LG are related to its sophisticated rules and narrative elements, as well as the diversity of multi-media contents it proposes. Nevertheless, the LG has not been finalized yet, and has not been play-tested with any students.

Summary of the chapter

This chapter provided, for each of the four case studies, a detailed analysis of the different themes explored in the study, in relation to teachers' creativity within the design and application of LGs. The discussion was based on data collected from multiple sources, methods and individuals, which provided a rich description of the themes. Afterwards, I outlined the particularities of each case. The next chapter compares results from the different cases, in order to highlight findings and answer the different questions posed by the research.

CHAPTER 7

Results and findings

Introduction

My research employed a multiple case study design. The last chapter provided, for each of the four cases, a detailed description of the themes explored through the study. According to Creswell (1998), this "within-case analysis" is followed by a thematic analysis among the different cases, called "cross-case analysis" (p. 63). Hence, the present chapter analyses the results for the different cases and highlights their similarities and differences, in order to interpret and make sense of results.

For each of the research dimensions, the chapter draws out the results from the four cases, and highlights findings by answering the corresponding sub-questions (SQ):

- *Process dimension:* SQ1 - How do teachers experience the game design process from the perspective of creativity?
- *Product dimension:* SQ2 -To what extent are the LGs designed by teachers creative?
- *Teaching dimension:* SQ3 - What are the practices at stake during the application of LGs in the classroom, in relation to creativity?

On this basis, I answer the overarching research question which was defined at the beginning of the study:

> *How can teachers' creativity be enhanced by an approach where they design and apply their own LGs?*

1. Process dimension: results and findings

This section highlights the results of my study regarding the process dimension, i.e. it describes, from the perspective of creativity, the process through which teachers designed their LGs. I first detail the game design process according to the stages established in the creative educational game design process model (see Chapter 3, Table 3), i.e. (a) task identification, (b) preparation, (c) response generation, (d) response validation, and (e) outcome. In addition, I describe the influences of the person (i.e. teachers' intra-individual components, including task motivation, domain-relevant skills and creativity-relevant processes) and press (teachers' environment, including the available resources, the curriculum and the social environment) dimensions on these stages. Finally, I answer the research question related to the process dimension, i.e. *how do teachers experience the game design process from the perspective of creativity?*

1.1. Game design stages

1.1.1. Stage 1: task identification

During this first stage, teachers decided to engage in the task (i.e. the design and application of their own LGs) and identified the pedagogical objectives of their LGs.

a) Engagement in the task

The educational centre (press dimension) appeared to play a critical role for teachers' engagement in the task. Indeed, for Cases 1, 2 and 3, they got aware of the opportunity to participate in the research through an innovative educational project in which their centres participate.

Furthermore, in line with Amabile's componential model of creativity (1983, 1996), task motivation (person dimension) played an important role for teachers' engagement in the task. Indeed, teachers' discourse revealed that different types of motivation stimulated them in undertaking the game design process. As shown in Table 24, motivation was both intrinsic and extrinsic, as teachers both valued the design process itself (i.e. they were interested in discovering and experimenting a new methodology, as well as found the task attractive and challenging) and its outcome (i.e. an effective and engaging learning resource, specially adapted to their students and pedagogical objectives). This is in line with the revision of Amabile componential model (1996), which proposes that certain extrinsic motivators, which support competence development and deep involvement in the work, can add to intrinsic motivation and creativity.

Types of motivation found in teachers' discourse		Case 1	Case 2	Case 3	Case 4
Intrinsic	Interest in discovering and experimenting a new methodology	X	X	X	X
	Attraction to the task		X		X
	Challenge of the task	X			
Extrinsic	Enhancing students' motivation	X	X	X	
	An effective resource which enables to reach high learning outcomes	X	X	X	X
	Getting closer to students			X	X
	A resource specially adapted to teaching needs and subjects taught	X		X	

Table 24: Types of motivation found in teachers' discourse, which stimulated them in engaging in the design process

In addition, although not mentioned in Amabile's model, creativity-relevant skills (person dimension) also influenced teachers' engagement in the task. Indeed, teachers' openness to experience and interest in the domain pushed them to undertake the game design process. In all cases, they showed a high level of interest in experimenting and discovering new methodologies, as well as in the domain at stake, i.e. GBL approaches.

b) Definition of the games' pedagogical objectives

Once they decided to undertake the task, teachers defined the pedagogical objectives of their LGs. Domain-relevant skills (person dimension) appeared to be determinant here. Indeed, results showed that they chose to address topics that they mastered. For example, the teacher from Case 4 decided to design a game related to modern music, a field in which he had a high level of knowledge, so he could develop content autonomously, without needing to proceed to further research. In addition, in all cases, teachers defined the pedagogical objectives of their LGs according to the specificities of the curriculum (press dimension), as well as their students' characteristics (press dimension), i.e. their age, socio-cultural contexts, and level of knowledge.

Figure 32 illustrates the influences of the person and press dimensions on the task identification stage.

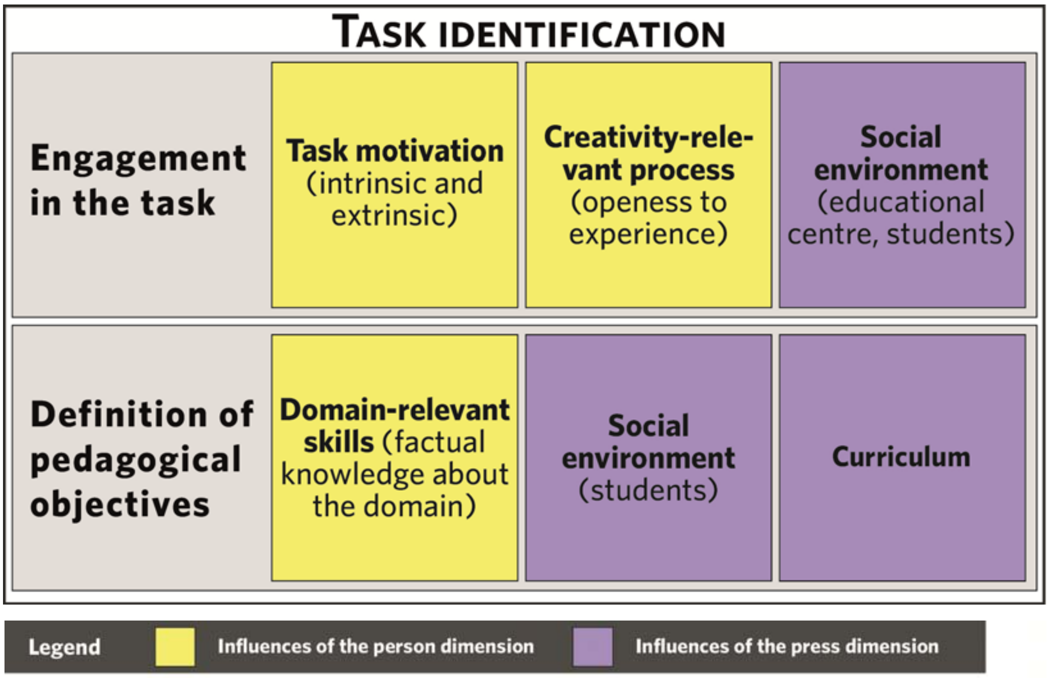

Figure 32: Main influences of the person and press dimensions on the task identification stage

1.1.2. Stage 2: preparation

At this second stage, teachers reactivated, reinforced or acquired a wide range of domain-relevant skills (Person dimension) and elements of knowledge:

- *Technical skills:* in order to create a functioning game, teachers learnt how to manage the functionalities of the eAdventure editor. As they had no knowledge on the editor at the outset, they found the learning process difficult, laborious and time consuming. Furthermore, they developed a wide range of different technical skills, such as the edition of pictures and audio files.

- *Collaborative skills:* teachers who designed their LGs in a collaborative manner reinforced their collaborative skills. For instance, teachers from Case 1 stated that they developed their ability to work in team, i.e. to be flexible with others', to synchronize, to consider others' ideas and to integrate different perspectives in a common work.

- *Game design and GBL:* among all the participants, the teacher from Case 4 was the only one with experience in games and GBL practices. Through the game design process, he reactivated and refined his skills regarding game design principles (i.e. the elaboration of narrative elements and game mechanics), and learnt how to apply them to his pedagogical contexts. Although the other teachers were trained about game design principles, they learnt about this aspect in an implicit manner, but did not reach a conscious understanding of game design principles.

- *Factual knowledge about the domain:* at the beginning of the design process, teachers had a high level of knowledge regarding the topics addressed in their LGs. Indeed, these topics are related to the disciplines they teach. Nevertheless, for Cases 1 and 3, contents became more and more deep and specialized as their games evolved. Hence, teachers had to acquire more related knowledge, in order to achieve complete and valid LGs. They found it pleasant and rewarding to refine their knowledge about the domain. Teachers from the other cases already had, at the outset, the necessary knowledge to elaborate the contents of their LGs. Hence, they could quickly reactivate this already stored information, and concentrate on acquiring skills related to other aspects of the design process (i.e. technical skills and game dynamics).

Furthermore, results revealed that the learning process occurred according to two different dynamics, which are detailed below.

a) Initial teacher training

The building of domain-relevant skills first took place during the training workshops, when teachers learnt about the eAdventure editor functionalities (domain-relevant skills) and became acquainted with basic principles on game design and GBL. Teachers considered the training intensive, useful, and sufficient to feel ready to start creating their LG. The tutorials and examples provided helped them to determine their first design ideas. The ProActive project (press dimension) played an important role at this stage, as the training workshops were provided in the context of its activities.

b) Self-regulated learning

Data analysis revealed that all teachers in the four case studies continued acquiring skills after the initial training workshops, during the response generation stage, in an informal manner, when they felt that they needed to.

During the elaboration and production steps, teachers from Cases 1 and 3 researched information related to the domain, in order to complete the games' educational content and audio-visual resources. To do so, they searched on the Internet, on site (e.g. in the streets and museums of their city), or by asking different actors of their social environment (press dimension), i.e. colleagues, the city council, and museum staff. This aspect of the design process corresponds to Crawford's research and preparation stage (1984), which highlights the importance, for the game designer, to immerse in the topic, by reading, researching, and understanding the environment that the game aims to represent. This process called for teachers' intrinsic motivation (person dimension), as they got the chance to interact with many actors from the community, and develop their expertise in their domain (person dimension).

Furthermore, during the production step, teachers from all cases continued exploring the eAdventure software functionalities while programing, often asking for support to the researcher (press dimension). Furthermore, they acquired other types of technical skills (e.g. the edition of pictures and audio files) while elaborating audio-visual resources.

This self-regulated learning process was continuous, progressive and contextual, as it took place according to the emerging needs of the game design process.

Figure 33 presents the influences of the person and press dimensions on the preparation stage.

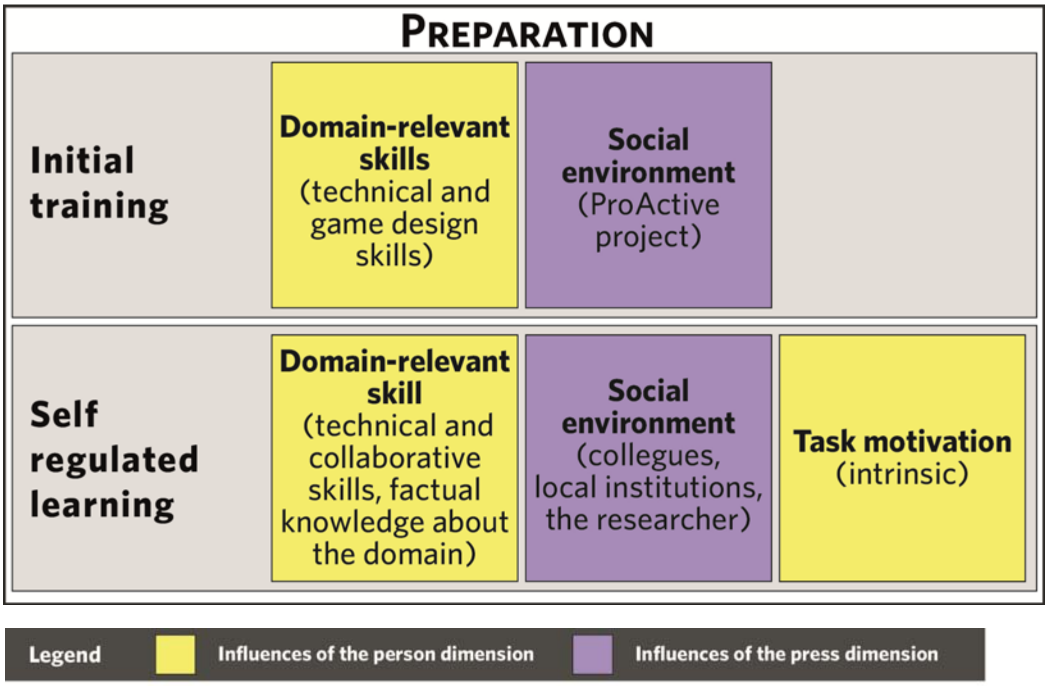

Figure 33: Main influences of the person and press dimensions on the preparation stage

1.1.3. Stage 3: response generation

On the basis of the previous stages, teachers generated ideas and response possibilities to create their LGs, through several game design activities, which are described below.

a) Conceptualization

Data analysis enabled to identify the different elements from the person and press dimensions which determined the conceptualization process (i.e. the definition, by teachers, of the core ideas for the design of the LGs):

- *Domain-relevant skills (person dimension):* for all cases, teachers determined their ideas according to their existing knowledge. Indeed, they preferred to work on topics mastered by at least one of the team members, so to feel comfortable with the subject, and be able to concentrate on other aspects of the game design process. Furthermore, some teachers from Case 1 were interested in working on a topic they did not master, in order to learn new domain-relevant skills and discover new areas of knowledge.
- *The curriculum (press dimension):* teachers developed ideas which could support their disciplines and the specific pedagogical objectives of the curriculum. For example, Cases 1

and 3 chose to work on the local history and traditions of their region, a subject which could match different disciplines and levels.

- *Resources available (press dimension):* teachers sometimes considered the resources which were available to them. Indeed, teachers from Case 2 conceptualized a LG on the basis of the resources which were available to them in the school, e.g. the bicycle workshop and the video-camera. As for Case 1, the affordances of the eAdventure software influenced the conceptualization process. Indeed, they argued that the specificities of the editor gave them the idea of working on a time travel.
- *Intrinsic motivation (person dimension):* for Cases 1, 3 and 4, teachers determined the ideas of their games on the basis of their personal interests (i.e. the history and traditions of their regions for Cases 1 and 3, and Rock music for Case 4).

From the moment teachers agreed on the idea of their game, they followed it all along the design process. This is in accordance with Adams and Rollings' suggestion (2007), that the fundamental aspects which constitute the basis of the game should not be changed.

b) Elaboration

This step consisted, for teachers, of elaborating and bringing together the different aspects of their games, i.e. educational contents, game elements (plot, characters, objects and scenes), and dynamics (objectives, rules and interactions with the player).

The elaboration of educational content required more or less time and efforts, according to teachers' domain-relevant skills (person dimension) and curricular objectives (press dimension). For example, for Case 1, the LG addressed broad pedagogical objectives related to various disciplines. Hence, teachers had to build a consistent system of contents, composed of various elements of knowledge from various disciplines of the curriculum, and adapted to the level of their students (press dimension). In spite of teachers' high level of knowledge in this field, they had to go back to the *preparation* stage in order to acquire the sufficient information to complete their LG. In contrast, for Case 2, pedagogical objectives were clearly defined, synthetic and static. As a result, teachers only had to organize content on the basis of their existing domain-relevant skills, without having to extend it or to search for new information.

Most of the time (Cases 1, 3 and 4), teachers elaborated a storyboard document which served to plan, in details, the elements and dynamics of their game. Furthermore, the storyboards more often contained the dialogues among characters. They were similar to the Game Treatment document suggested in Rollings and Adams' game design model (2007). Teachers frequently asked for support to the researcher (press dimension) in order to check the feasibility of the interactions planned in the storyboards. To most of them, the storyboard acted as a guide for the design process. It helped them to concretize their ideas, by refining them and mapping them in a complete vision of the game. Furthermore, they could see whether those ideas were feasible or not, considering the specificities of the eAdventure editor. Hence, it enabled them to plan the further step of the design process, i.e. the production of the game. In contrast, some teachers from Case 3 stated that the elements defined in the storyboard had to be adjusted during the *production* step (programing process). As a result, they sometimes preferred to work directly with the editor, in order to instantaneously evaluate the feasibility of their ideas. Only teachers from Case 2 decided to not create a storyboard. Indeed, they considered that their idea was clear and simple, and preferred to work directly with the editor.

c) Production

This step consisted of two main activities, i.e. the creation of audio-visual resources and the process of programing of the game interactions with the eAdventure editor.

Creation of audio-visual resources

Teachers determined the different graphical and audio resources which would give life to their games. Although the eAdventure software includes a library of visual resources, they preferred, in all cases, to create their own resources, especially adapted to the contexts of their LGs. According to the cases, they chose to use different types of resources, as illustrated in table 25.

Types of audio-visual resources	Case 1	Case 2	Case 3	Case 4
Graphical resources found on the Internet and edited	X			X
Pictures and videos directly made on the field	X	X		
Graphical resources created by a professional graphic designer	X		X	
Audio resources created by recording students' and colleagues' voices	X		X	

Table 25: Types of audio-visual resources created by teachers

Many of the teachers (Cases 1, 2 and 3) had to go back to the *preparation* stage, in order to acquire the necessary technical skills to edit audio-visual resources.

The creation of audio-visual resources enabled them to focus their attention on the details of their environment. Indeed, they created graphical elements on the basis of what they found in their surroundings. For example, teachers from Case 1 elaborated the scenes of their game on the basis of pictures from the streets, monuments and important sites of their city. Moreover, teachers from Case 2 made pictures of the settings and tools of their centre's bicycle workshop in order to create the scenes and objects of their LG. Hence, teachers exploited their spatial and material resources (press dimension) in order to create audio-visual resources.

In addition, teachers involved different actors of their social environment (press dimension) to create their resources. Teachers from Case 1 asked for permissions to the administrations to take pictures, and met different actors from their city. Furthermore, they recorded their colleagues' and students' voices to build audio resources. For Case 2, teachers involved students as the game's protagonists. Finally, teachers from Case 3 recorded students with language disorders for the voices of the characters. This enabled them to reach parallel pedagogical objectives (i.e. get students to memorize texts, to dare talking in front of others, and being recorded for a game which would be played by external audiences).

This part of the work was considered to be particularly rewarding, and called for teachers' intrinsic motivation (person dimension), i.e. challenge, interest, satisfaction and enjoyment. Teachers from Case 1 enjoyed going to the field and meeting people in order to ask for permissions for taking pictures. Teachers from Case 2 were proud of having created all the resources of their game (pictures, videos and sounds) from scratch, and obtained a realistic game, close to students' environment and reality. Teachers from Case 3 found it positive to involve their students in the game design process. Furthermore, they particularly enjoyed the moments in which they saw the graphical and sound elements giving life to their game. Finally, the teacher from Case 4 was proud of having produced all the graphical resources of his game. This process was the part of the design process he most enjoyed.

Programing

Finally, teachers integrated the audio-visual resources and programmed the interaction system of their games with the eAdventure editor.

This part appeared to be difficult, laborious, time-consuming, and involved an important learning process. Indeed, results showed that teachers often had to go back to the *preparation* stage, in order to learn more about the editor's functionalities (technical skills) so to be able to program the actions planned at the elaboration step. They often asked for support to the researcher in order to solve the problems they encountered with the software.

Furthermore, results showed that the digital environment (i.e. the eAdventure editor) did not support the realization of many ideas developed by teachers at the at the elaboration step. Hence, programing strongly related to the response validation stage. Indeed, teachers validated, adapted or discarded their ideas as they were programing. In the end, they often had to simplify their ideas so that they could be supported by the software.

Although teachers from Cases 1, 2 and 3 did not enjoy the programming process, the teacher from Case 4 positively valued it. He described it as a discovery process, by which one tries, selects or discards solutions. In any case, the programing process was challenging, and required a lot of concentration in order to correctly link actions and to obtain the expected answer. Teachers' creativity-relevant processes (i.e. their orientation towards working hard and their persistence) helped them to achieve a functioning game. Nevertheless, it appeared that, for all cases, teachers had to dedicate a high amount of time and efforts to programming, to the detriment of the other aspects of the game design process (e.g. game dynamics and pedagogical strategies).

Figure 34 illustrates the influences of the person and press dimensions on the response generation stage.

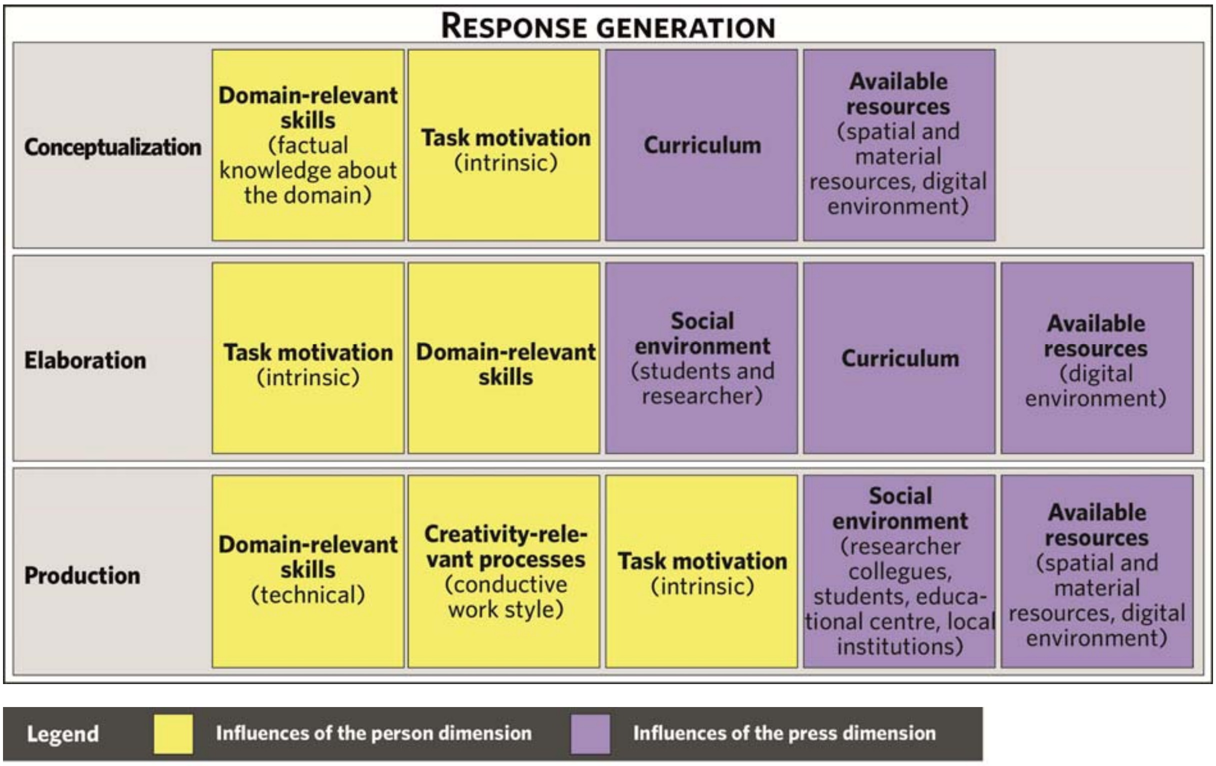

Figure 34: Main influences of the person and press dimensions on the response generation stage

1.1.4. Stage 4: response validation

In line with many game design frameworks (Adams & Rollings, 2007; Fullerton, 2008; Salen & Zimmerman, 2004), teachers evaluated, in several occasions, the response possibilities generated at the previous stage, through an iterative process.

For Cases 1, 2 and 4, teachers showed a high level of flexibility, and adjusted response possibilities in a continuous way, through various cycles of adaptations and changes. They adapted and extended their game ideas with new elements of knowledge, new scenes and new characters, according to what the game was asking them. Hence, the production and validation of response possibilities was done according to a natural, blind and random process. Teachers described their game "as an open creation", growing "on its own", "like a human being" (Annex 8.1.4). In contrast, teachers from Case 2 had a clear idea of their game contents and dynamics from the outset, and did not undertake major changes. They only proceeded to slight adaptations in the interactions modes between the player and the interface when necessary.

Results showed that response validation was performed according to different criteria (see Table 26):

- *Relevance to the domain:* as mentioned earlier, teachers from Cases 1 and 3 refined their knowledge about the domain along the design process. They reviewed and adapted the content of their LGs accordingly.
- *Students' profile:* teachers from Cases 1, 3 and 4 constantly evaluated the game elements against the profile of the groups of students and their level of knowledge. Teachers from Case

2 did not mention this criterion, as they had simple and clear educational objectives since the beginning of the process, which they did not need to review.

- *Time constraints:* for all cases, teachers had to simplify or discard some of their ideas because they did not have enough time to implement them.
- *Editor's affordances:* teachers also simplified their initial ideas as they discovered the editor's functionalities, and realized that they could not support them.

Response validation criteria	Case 1	Case 2	Case 3	Case 4
Relevance to the domain	X		X	
Students' profile	X		X	X
Time constraints	X	X	X	X
Editor's affordances	X	X	X	X

Table 26: Response validation criteria

To Amabile (1983, 1996), the response validation stage serves to determine whether responses and ideas are appropriate, useful, correct and novel. Nevertheless, results showed that the validation criteria often related to the constraints of the environment (i.e. the time available and the editor's functionalities). Hence, it appeared that teachers had to give priority, when validating their ideas and the elements of their games, to the feasibility constraints imposed by their external environment, to the detriment to the creativity of their ideas (i.e. their relevance to the domain and their novelty), in order to achieve a functioning game.

Results highlighted different practices employed by teachers to evaluate their ideas and the elements of their LGs, which are described below.

a) Self-testing

For all cases, teachers tested the feasibility of their ideas with the game editor (press dimension), through a trial and error process. They continuously adapted the game elements when necessary, until achieving a functioning game. Furthermore, as they were discovering the functionalities of the editor, they figured out ways to improve elements previously designed. In addition, teachers reviewed and adapted the educational content as they were developing their expertise in the domain (person dimension).

b) Peer review

Teachers from Cases 1 and 3 often asked for the opinion of their colleagues (press dimension) in order to evaluate their games' content and interaction modes. For example, teachers from Case 1 stated that they often worked on their game in the teachers' room, and informally received feedback from the colleagues around them.

c) Online support

Except for Case 2 (teachers decided to conduct the design process in an autonomous manner), teachers frequently asked for support to the researcher (press dimension) in order to evaluate the feasibility of their ideas regarding various aspects, i.e. the GBL scenario, the interaction modes, and usability aspects.

d) Play-testing sessions with students

Teachers from Cases 1 and 3 continuously involved their students (press dimension) in order to evaluate the adequacy of their games for the targeted audience. To do so, they informally organized play-testing sessions, in which students had the opportunity to play the scenes, see the characters, and comment on the games. Teachers from Case 2 showed the game to students at the end of the design process. They provided some comments and feedback, mainly on usability topics, which were written down by teachers. As for Case 4, the teacher did not involve students in the design process, but implicitly made sure that the game content and dynamics were adapted to their profile.

The influences of the person and press dimensions on the response validation stage are illustrated in Figure 35.

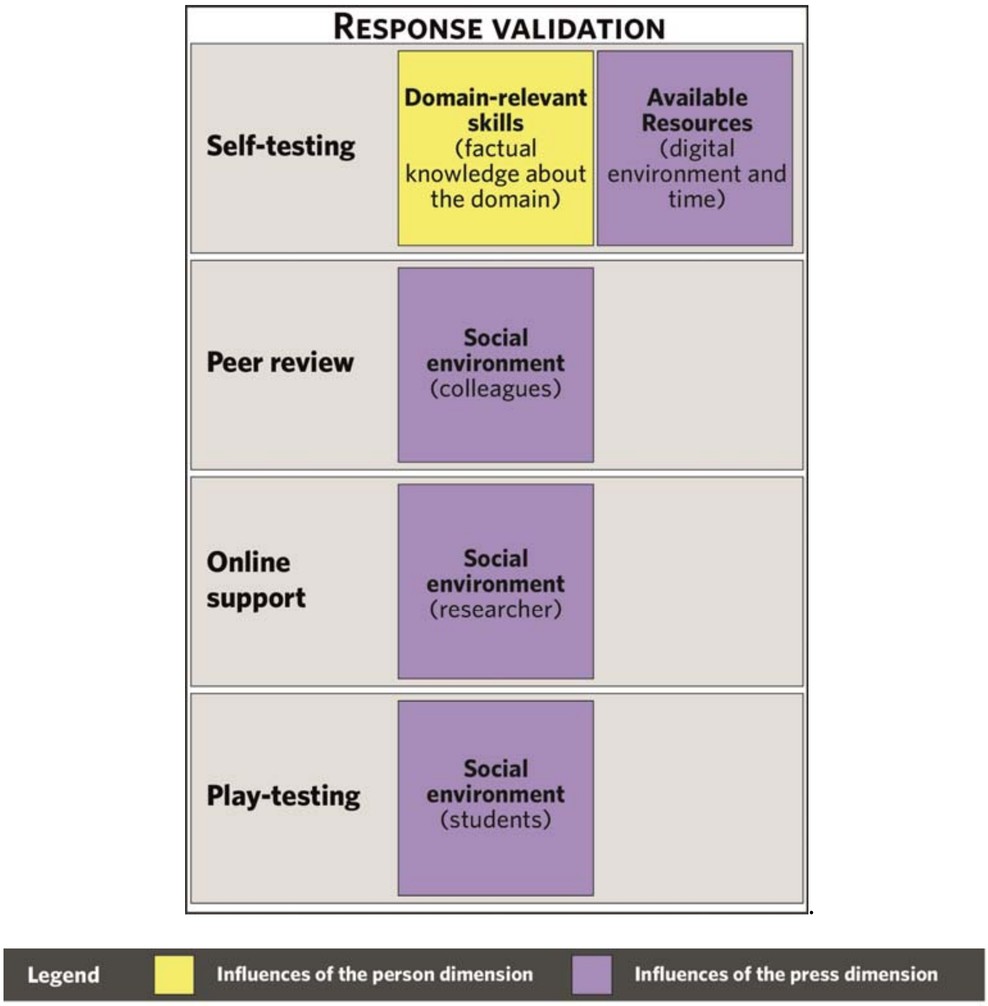

Figure 35: Main influences of the person and press dimensions on the response validation stage

1.1.5. Stage 5: outcome

This final stage describes teachers' perceptions on the outcome of the game design process (i.e. the LGs created), and the way they communicated it among the community.

a) Evaluation

Teachers were generally satisfied with the outcome of the design process, and considered having achieved their objectives, i.e. to create a functioning game, test the potential of GBL and eAdventure, work with ICT, and for Case 1, carry out a collaborative project. Only the teacher from Case 4 did not reach his objective (i.e. achieve a complete LG), but progressed towards it and planned to finalize it.

Nevertheless, teachers outlined that some aspects of their games would need to be improved, i.e. the quality of graphical elements and animations, the interaction system, game mechanics, and the level of details of contents. These elements correspond to the ones they had to neglect for environmental constraints (press dimension) at the response validation stage. They admitted that their LGs cannot compete with COTS, and are not so attractive for their students (press dimension), as they are used to play games with a higher quality of graphics and interaction. This aspect is further described in the results of the product dimension (Section 2).

b) Communication

For most cases, teachers considered their games to be useful for their teaching contexts and objectives. Furthermore, they argued that they were suitable for other educational contexts and for different profiles of learners. Hence, besides of using the games with their students, teachers diffused them among the educational community (press dimension), and reached a wide audience. For example, teachers from Case 1 presented their LG for the Telefónica Foundation Educared educational innovation award (2011) and won the first price. As his game has not been finalized, the teacher from Case 4 has not diffused it yet. Nevertheless, he is currently in contact with the Rock museum of Barcelona, for an eventual contract to finance the game development and exhibition in the museum. In contrast, teachers from Case 2 have not diffused their game outside the classroom. To them, the game objectives are specific, and can only be applied in their particular teaching contexts. More generally, all teachers diffused their LGs among the ProActive project community.

c) Exploitation

Interestingly, although not mentioned in the game design and creativity frameworks, the outcome stage offered teachers opportunities for the exploitation of their projects. Indeed, teachers from Cases 1 and 4 are currently negotiating with local institutions (press dimension), respectively, the city council of A Coruña and the Museum of Rock of Barcelona, to adapt their games in order to be widely diffused. Hence, teachers' social environment appeared to present interesting opportunities to continue and exploit their educational projects.

Figure 36 illustrates the influences of the person and press dimensions on the outcome stage.

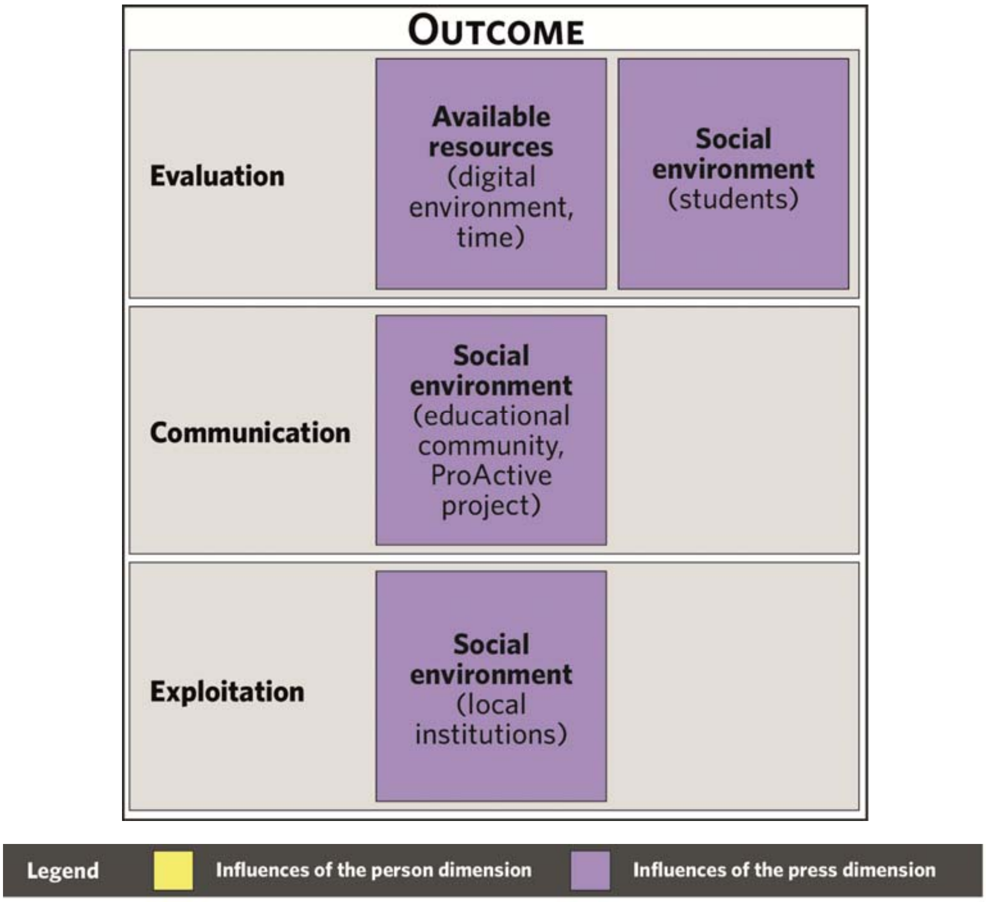

Figure 36: Main influences of the person and press dimensions on the outcome stage

1.2. Influences of teachers' intra-individual components: person dimension

The following paragraphs present the main results regarding the influences of teachers' intra-individual components (i.e. task motivation, domain-relevant skills and creativity-relevant processes) on the different stages of the game design process.

1.2.1. Task motivation

As expressed in Section 1.1, data analysis showed that both intrinsic (interest, enjoyment, attraction and challenge of the game design activities themselves) and extrinsic (the outcome of the design activity, i.e. a powerful teaching resource specially adapted to their teaching needs, which would enable to enhance students' motivation and get closer to them) motivators positively influenced the game design process. Furthermore, in line with Amabile's componential model of creativity (Amabile, 1983, 1996), I found that these motivators influenced teachers at different stages of the design process:

- *Task identification:* as explained earlier, both intrinsic (the task itself) and extrinsic (the outcome of the task) motivators determined teachers' decision to engage in the game design process.

- *Preparation:* although not mentioned in Amabile's model, intrinsic motivation appeared to stimulate teachers to research and learn about the environment that their games attempted to represent. Indeed, they found this part particularly rewarding.
- *Response generation:* intrinsic motivation also impacted this stage. Indeed, teachers' personal interests determined the conceptualization of their games' core ideas. Furthermore, they showed a high level of intrinsic motivation (i.e. challenge, interest, satisfaction and enjoyment) which maintained them engaged in the game design activities, in spite of the high amount of time and efforts required (elaboration and production steps).

More generally, teachers found the design process enjoyable. Teachers' discourses denoted some indicators of flow (Csikszentmihalyi, 1990, 1996), i.e. concentration, loss of self-consciousness and autotelic experience. They also evidenced the presence of traits of creative people highlighted by the author (i.e. passion and interest in the domain), as well as individual resources from the Investment Theory (Sternberg & Lubart, 1991, 1995), i.e. willingness to overcome obstacles and to take sensible risks. Indeed, the challenge of the task appeared as a strong motivational element for teachers. At the outset, most of them did not feel capable of achieving a functioning game. By solving progressive challenges and reaching small goals, they progressed towards their final objective.

1.2.2. Domain-relevant skills

As mentioned earlier, domain-relevant skills include everything that the individual knows and can do in the domain in question, i.e. teachers' knowledge regarding the subject taught through their game, game design principles and technical skills. Data analysis showed that these skills influenced different stages of the design process, as explained below.

- *Task identification:* although the influence of domain-relevant skills on this stage is not mentioned in Amabile's model (Amabile, 1983, 1996), teachers' expertise determined the definition of games' pedagogical objectives. Indeed, they chose to address topics that they mastered.
- *Preparation:* in line with the componential model of creativity, teachers reactivated, reinforced or acquired, in a continuous and iterative manner, the domain-relevant skills (i.e. technical and collaborative skills, as well as game design principles) and knowledge (i.e. factual knowledge related to the game content) necessary to undertake the game design task.
- *Response generation:* the influence of domain-relevant skills on response generation stage was not mentioned in Amabile's model. However, it clearly appeared in my study. Indeed, teachers' knowledge about the domain determined the conceptualization step, i.e. the generation of the games' initial ideas, as they thought about topics which they mastered, or, in some cases, they could learn about. Furthermore, teachers' expertise in the topics addressed in their games conditioned the elaboration step, while their technical skills (management of the eAdventure functionalities and edition of audio-visual resources) determined the production step.

- *Response validation:* in line with Amabile's model, teachers' knowledge about the domain determined the evaluation of the game elements. Indeed, response possibilities were tested against the knowledge and criteria included within domain-relevant skills.

1.2.3. Creativity-relevant processes

I investigated, in teachers' discourses, the presence of some personality characteristics, cognitive styles, and work habits that promote creativity, i.e. their tolerance for ambiguity, openness to experience, self-discipline, willingness to take risks, and persistent work style. Results showed that different types of creativity-relevant processes influenced several stages of the game design process:

- *Task identification:* Amabile's model (Amabile, 1983, 1996) did not highlight the influence of creativity-relevant processes on this stage. However, in all cases, teachers' openness to experience (i.e. their interest in experimenting and discovering new methodologies) and interest in the domain (i.e. GBL approaches) encouraged their engagement in the task.
- *Response generation:* creativity-relevant processes, i.e. teachers' conductive work style (all teachers highlighted the high amount of time, effort and persistence they put in order to achieve the tasks at this stage) and risk-taking (they did not mind engaging in challenging tasks to reach their objective) influenced the elaboration and production steps.
- *Response validation:* Amabile's model does not mention the possible influence of creativity-relevant skills on this stage. However, teachers' flexibility, tolerance for ambiguity and ability to keep response options open (teachers from Cases 1, 3 and 4 did not mind adjusting their ideas continuously, according to a blind and random process), helped them to adapt and improve their ideas when necessary.

1.3. Influences of teachers' environment on the game design stages: press dimension

Although Amabile's componential model of creativity (Amabile, 1983, 1996) highlights the importance of the environment on creativity, it does not detail its influences on the different stages of the creative process. This section details the main results regarding the role of teachers' environment (i.e. the resources available to them, the curriculum, the different actors which composed their social environment, and the collaborative processes among the creators) on the game design process.

1.3.1. Available resources

The following paragraphs present the results of the study regarding the role of the time, spatial and material resources available to teachers, and the digital environment on the design process.

a) Time: a constraint to teachers' creativity

Because of the duration of the study, teachers had a limited time to design their LGs. However, the design process involved, for all cases, a high amount of time dedication. Indeed, at the preparation stage, teachers dedicated a lot of time to acquire the necessary skills (i.e. technical skills) and knowledge (i.e. factual knowledge about the domain) to complete their LG. At the response generation stage, the elaboration and production steps appeared to be very time-consuming. Finally, time appeared to have a strong influence on the response validation stage. Indeed, to teachers, it represented a conditioning element, as they constantly had to simplify or discard the ideas they had generated in order to finalize their LGs on time. Hence, time acted as a constraint to teachers' creativity. Furthermore, the time involved by the game design activities appeared to be incompatible with teachers' daily practices.

b) Spatial and material resources: a facilitator to the design activities

For all cases, the spatial and material resources available to teachers, i.e. the educational centres' infrastructure and materials (e.g. spaces, computers, digital and movie cameras) were sufficient to allow for the achievement of the design activities. Indeed, teachers had the necessary resources to take pictures and shoot movies, edit audio-visual resources, as well as run the eAdventure editor (response generation stage, production step). Furthermore, at response validation, they could show the game to students on digital whiteboards, so to carry out collective play-testing sessions. Hence, spatial and material resources available in the educational centres appeared to facilitate the design process.

c) The digital environment: a limit to realise teachers' ideas

The digital environment (i.e. the eAdventure editor) fashioned the game design activities. It enabled teachers to create tangible outcomes, by allowing processes of design and edition of the interactions between the different elements of the games. Nevertheless, to most teachers, the editor did not support the development of their ideas. Rather, it made it more difficult, for the reasons mentioned below.

At the preparation stage, teachers learnt how to use eAdventure's functionalities. They generally considered the editor as little intuitive and difficult to learn. At response generation (conceptualization and elaboration steps), they considered the characteristics of the editor to determine the ideas of their games. Nevertheless, most teachers felt that, at the production step, the software did not support the development of these ideas. Furthermore, they described it as complicated to use, and argued that programing simple actions involved a high amount of time and efforts. Consequently, at response validation, they had to constantly adapt or discard their ideas according to the software functionalities.

Hence, for most cases, the editor did not facilitate the emergence of ideas. Rather, it was found to "force" teachers' creativity (Annex 8.2.1). They argued that it lacked many affordances, such as the possibility to design a 3D game, to set more complex and dynamic interactions. Furthermore, they encountered difficulties in using some of its functionalities, such as integrating videos and setting conditions and effects. Teachers experienced frustration while using the editor, and argued that working with it was laborious. Only the teacher from Case 4, who had previous game design experiences, considered that the editor offers a wide range of functionalities which allows for the creation of complex games, in comparison with other editors that he used in the past.

At the end, in spite of some usability concerns, the eAdventure game editor constitutes a sophisticated design tool which offers a wide range of functionalities. Nevertheless, its optimal use requires a wide range of technical skills, related to programing, as well as an important learning load and regular support. These requirements did not match the context of the design process (i.e. time available and teachers' technical skills). Hence, teachers' negative appreciation of the editor may be due to the context of the design process, which did not allow for its optimal use.

1.3.2. The curriculum

The curriculum played a predominant role during the process of design of the LGs. Indeed, in order to obtain a beneficial game that they would be able to use in their teaching contexts, teachers considered their curricular objectives at different stages, i.e. during the definition of the games' pedagogical objectives (task identification), as well as the conceptualization and elaboration steps (response generation).

1.3.3. Teachers' social environment

Different actors of teachers' social environment had a determinant role during the design process, i.e. their educational centres, colleagues, students, but also external institutions, as explained below.

a) The educational centre: a valuable support to the game design activities

For Cases 1, 2 and 3, teachers' educational centres played a determinant role in the design process. Indeed, teachers argued that their schools' management was supportive during the whole design process, by encouraging teachers towards the achievement of the task. Their centres participated in the Ponte dos Brozos innovative educational project, which provided teachers with a context for undertaking the game design process. Indeed, at the task identification stage, teachers got aware of the task through the *Ponte dos Brozos* project activities. Furthermore, at the response generation stage (production step), the project provided teachers with economical resources to contract graphic designers (Cases 1 and 3).

As for Case 4, the educational centre supported the participation of the teacher in the study, but did not play a determinant role during the design process. The teacher showed his LG to his colleagues, but they did not show any particular interest. This can be explained as Teacher 4 conducted innovation in an autonomous manner.

b) Colleagues: mirrors to teachers' work

Teachers from Cases 1, 2 and 3 counted on the help of their colleagues at different stages of the design process. For example, at the response generation stage (production step), teachers' colleagues gave their voices to the games' characters. Furthermore, at response validation, teachers from Case 1 received feedback from their colleagues on different aspects of their game (e.g. contents, interaction modes and usability aspects), and took their opinions into account to make improvements.

c) Students: the centre of the design process

For Cases 1, 2 and 3, teachers involved their students at different stages of the game design process. At the task identification stage, they decided to engage in the task in order to create engaging and efficient learning resources for their students. Furthermore, they considered their specificities (i.e. their socio-cultural characteristics and level of knowledge) in order to define adapted pedagogical objectives. During the response generation stage (elaboration step), they also designed their games' contents and interactions considering learners' profile. At the production step, some students gave their voices and images to the games' characters. Furthermore, at the response validation stage, they provided insights on the game content, the level of difficulty, and the interaction design.

d) External institutions: unexpected partners

Surprisingly, external institutions played an important role in the design process. At preparation, teachers researched information related their games' environment, by asking different actors from local cultural institutions (e.g. the city council, museums). There, they found collaborative people who supported their projects and provided a valuable help at the response generation stage, for the elaboration of contents (elaboration step) and the creation of resources (production step).

External institutions also played an important role at the outcome stage, when teachers diffused their LGs to the educational community. Indeed, teachers from Case 1 disseminated their game to a wide audience, through local museums, the city council, and the Telefónica foundation. Furthermore, some external institutions (the city council of A Coruña for Case 1, and the Museum of Rock Music of Barcelona for Case 4) proposed teachers funding to continue their LGs, thus providing opportunities for exploitation.

e) The ProActive project: the enabler of the design process

Without the ProActive project, the design process would not have occurred. Hence, it seems appropriate to describe its influences on each of the stages. The members of the ProActive research project (including the researcher) played, for all cases, a determinant role during the whole design process. At task identification, they provided teachers with a context to design their LGs, and gave them the opportunity to engage in the task. At the preparation stage, the researcher provided them initial training regarding the necessary skills to undertake the task, and remained available for online support during the while design process. During response generation and response validation stages, the researcher regularly provided support to teachers, regarding technical and game design skills, and guided them towards the achievement of their LGs. Finally, at the outcome stage, ProActive gave teachers the opportunity to diffuse their LGs among the project community and beyond.

1.3.4. Collaborative game design

For three of the cases studied, teachers decided to undertake the task in a collaborative manner, i.e. forming small groups of teachers working on the same LG. The next paragraphs describe the results of the research regarding collaborative game design processes, by identifying successful group processes, highlighting indicators of group flow, and describing teachers' pattern of collaboration.

a) What have been the factors for successful collaboration?

Data analysis showed that collaborative processes facilitated the game design process, and highlighted a good functioning of the different teams, as well as a collective professional growth. The following paragraphs identify the different aspects which allowed for successful collaboration.

Diversity of profiles

For all cases, group members had different professional profiles and skills. Indeed, some members were experts in the domains taught through the games, while others had higher technical skills. In line with John-Steiner (2000), this diversity and complementarity in teachers' profiles and skills facilitated the design activities. Indeed, each teacher had a different domain of expertise useful for the achievement of the LG. Consequently, they could share different visions and split tasks according to their domains.

Flexibility and spontaneity

For all cases, the distribution of tasks was done in a spontaneous and informal manner, without pre-established rules, according to a mutual agreement. Only for Case 3, teachers worked on the basis of basic rules, which were flexible according to people preferences and the evolution of the design activities. In all cases, teachers shared the different tasks involved by the game design process according to their respective skills, interests, and personal qualities.

Nevertheless, teachers easily switched their roles when needed, and did not always perform tasks which were in line with their skills. In Case 1, some teachers, although not experts in the discipline taught through the game, got very interested in the topic, and actively participated in the elaboration of contents. Furthermore, for Case 2, when the programming part involved a pick of work, the first teacher spontaneously helped the other. Hence, the distribution of tasks and legislation within the groups was characterized by spontaneity and flexibility, which are attributes of John-Steiner's *family collaboration* (John-Steiner, 2000). Teachers considered this aspect to be a success factor for the design process.

Flexible leadership

For Cases 1 and 3, the leadership was centralized to one of the team members. This was not formally decided; rather, it happened in a spontaneous way, and was naturally accepted by all team members. For Case 1, the leading teacher was considered to be a technical expert. This expertise provided him with the best criteria to organize the work methodology. As for Case 3, the leader's role was to bring a global perspective on the different tasks of the game design process. In spite of this centralized leaderships, all decisions were performed on the basis of a consensus among the members of the groups, in an inclusive atmosphere. Hence, in line the conditions of group flow defined by Sawyer (2007), all members could feel control and autonomy on their actions. As for Case 2, the decision processes were also distributed among the two team members. Nevertheless, the distribution of roles among teachers did not lead to the establishment of a leader.

Informal communication

Teachers mainly communicated synchronously, through regular meetings (at the school or during their free time) in which they decided how to share the design tasks. Furthermore, some steps of the design process, such as the production of resources and the final edition of games, involved intensive work cycles. In those cases, teachers multiplied communication processes and channels, by using e-mails, chat and phone. In line with Sawyer's conditions for group flow (2007), this intensive communication was considered to be essential for an effective collaboration and for the synchronization of tasks. Furthermore, communication was informal and spontaneous.

Trustful relationships

Teachers from Cases 2 and 3 had previously worked together in various projects; they knew at each other's performance styles, and mentioned a mutual trust among team members. This familiarity (Sawyer, 2007) and shared history among members enhanced the establishment of a common culture, continuity and a customary way of working (Eteläpelto & Lahti, 2008). In contrast, teachers from Case 1 had only collaborated in the context of sporadic educational projects and activities. They decided to work together as they realized they had similar interests. Nevertheless, they could quickly build familiarity and trustful relationships.

For all cases, teachers' discourses regarding their team denoted synergy, enjoyment, positive emotions, trust and security. Teachers referred to each other's contribution in a positive manner. Furthermore, all members were highly committed to the task and to the other members of their teams, in an emotional and affective way. They shared a passionate interest in achieving the task, which was determinant for the achievement of their goals. These findings are in line with previous research on the role of emotional aspects (John-Steiner, 2004; Eteläpelto and Lahti, 2008).

Interviews also denoted respect for each other and for different perspectives, expectation of good will, mutual care taking and confidence in others' abilities to contribute to the task (Eteläpelto & Lahti, 2008). Indeed, teachers took into account the opinions of their colleagues. Despite their alternative perspectives, teachers' discourses did not highlight any tensions. Furthermore, they displayed solidarity for their teammates, i.e. they helped at each other to overcome difficulties, towards the achievement of their common objective. Hence, in line with Sawyer's conditions of group flow, they shared a common understanding of the objective to be achieved (Sawyer, 2007). Although teachers' relationships were characterized by safety, they sometimes experienced challenging situations, in which they had to persevere in order to reach their goal. In line with Csikszentmihalyi (1996), these situations reinforced teachers' relationships.

To sum up, teachers' relationships were characterized by a balance between structure and flexibility, equity and autonomy, as well as trust and challenge. This equilibrium fostered their enjoyment in the task and their efficiency as a group towards a shared endeavour.

b) Indicators of group flow

Several conditions of group flow (Sawyer, 2007) were highlighted in teachers interviews, i.e. group' goals (teachers shared common visions towards their objectives), close listening (they took each other's opinions into account), control (in spite of the centralized leadership which characterized some of the groups, teachers felt autonomy and control on their actions), blending egos (a synergy among the different teachers enabled to reach common endeavours), equal participation (all teachers accorded the same dedication to the tasks), familiarity (teachers' relationships were characterized by trust and security), communication (teachers communicated in a constant, spontaneous and informal manner), moving it forward (they built on each other's ideas to make the most of their skills and qualities), and potential for failure (the task was considered to be challenging). These factors allowed for the emergence of a collective zone of proximal development, in which dynamic processes of co-construction occurred, as teachers served as resources for each other.

c) Pattern of collaboration

Regarding Cases 1 and 2, teachers' collaboration processes seemed to closely relate to John-Steiner's family collaboration (John-Steiner, 2000). Indeed, group processes were characterized by flexible roles which evolved along the design process, according to the need of the game development. Group members shared a common vision of their project. Furthermore, partnerships resulted in long-terms collaborations, as teachers mentioned that they would conduct further projects in which they would commit to each other's for a long time. Hence, groups may be transformed, with time, into integrative collaborations.

In contrast, the team from Case 3, in which teachers have been collaborating for a long time, can be considered to be an integrative partnership. Indeed, teachers have been working in the context of many educational projects, towards common goals and a shared ideology, i.e. enhancing innovation in education, thus transforming both the field (i.e. the educational system) and the participants (i.e. teachers).

1.4. Answering SQ1: How do teachers experience the game design process from the perspective of creativity?

On the basis of the results described above, I answer the research question related to the process dimension. To describe the design process from the perspective of creativity, I validate, improve and complete the creative educational game design process model, which was proposed in Chapter 3 (p. 80).

1.4.1. The stages of educational game design by teachers

In line with the creative educational game design process model defined in Chapter 3, teachers experienced the task identification stage by engaging in the task and defining their games' pedagogical objectives. At preparation, besides initial training, results highlighted another cycle of activities, i.e. a self-regulated process through which teachers acquired the necessary skills to progress in the design activities, in a contextualized manner. The response generation stage occurred according to the three game design steps identified in Chapter 3, i.e. conceptualization, elaboration and production. As for response validation, results highlighted different evaluation practices, i.e. self-testing, peer review, online support and play-testing with students. Finally, besides evaluation and communication, data analysis revealed an eventual third step to the outcome stage, i.e. exploitation, through which teachers took their projects further, in a different context.

Hence, the stages set in the componential model of creativity (Amabile, 1983, 1996) can be applied to the context of educational game design by teachers, as elaborated on the basis of Adams and Rollings (2007), Fullerton (2008) and Morales (2012). Indeed, educational game design activities (i.e. the definition of the pedagogical objectives, conceptualization, elaboration, production and play-testing) could be modelled on the stages proposed in Amabile's model (i.e. task analysis, preparation, response generation, response validation and outcome).

1.4.2. An iterative process

As stated in the model elaborated in Chapter 3, the stages of the game design process appeared to be iterative. Indeed, teachers experienced each stage several times during the design process, as explained in the next paragraphs.

After the task identification stage, teachers passed by the preparation stage a first time during the training workshops, so to get acquainted with the necessary skills to undertake the design process. Afterwards, at response generation, they produced solutions possibilities through different activities, i.e. conceptualization (definition of the core ideas of the game), elaboration (definition of the game contents, elements and dynamics), and production (creation of audio-visual resources and programming). The elaboration and production steps often required to go back to the preparation stage, as teachers needed to refine and complete their factual knowledge about the domain, as well as develop their technical skills, in order to achieve a complete, valid and functioning game.

Response possibilities were validated, adapted or discarded during the response validation stage. In the last two cases, teachers had to go back to response generation in order to adapt response possibilities, or generate new ones. Hence, the response generation and response validation stages are closely related.

Finally, once they had reached a functioning game (outcome stage), teachers determined whether they had achieved their objective or not (evaluation step). Furthermore, the exploitation step sometimes provided them the opportunity to continue their game. In that case, they went back to response generation (elaboration step), to add on content and dynamics.

Iterations occurred in all cases, to a lesser or greater extent, according to the cases' specificities.

1.4.3. An ecological process

My study highlighted a major importance of the influences of the intra-individual and environmental elements on the stages of the design process. Indeed, game design required teachers to apply and develop a wide range of domain-relevant skills (expertise in the domain, innovative methodologies, and ICT skills), creativity-relevant processes (openness to experience, persistent work style and flexibility), while experiencing both intrinsic and extrinsic motivation.

Furthermore, game design was determined by teachers' environment. They had to adapt the design process according to the time available to them, and could profit of the spatial and material resources available in their centre. The digital environment determined the design process. Teachers had to adapt their ideas to its functionalities. In addition, game design most often depended on the different actors of the educational community (i.e. the educational centre, colleagues, students and external institutions). Furthermore, teachers working in teams experienced rich collaboration processes, in which dynamics of co-construction occurred, as they served as resources for each other, exploiting their different profiles towards common goals. They worked in a flexible, spontaneous manner, thus developing trustful relationships and sustainable collaborations.

Hence, teachers' creativity, in the process of game design, is situated at the heart of a complex system which includes interrelated elements, i.e. the intra-individual resources (domain-relevant skills, creativity-relevant processes and task motivation), the educational community (i.e. students, colleagues and the educational centre), the curriculum, the local environment, and the digital environment. Consequently, a multidimensional approach of creativity is fundamental to the study of educational game design.

Figure 37 represents my validated CEGAD model of Creative Educational GAme Design. It presents the different stages of educational game design by teachers, from the perspective of creativity. Furthermore, it includes the influences of the person and press dimensions, as well as the iterative cycles, represented by arrows.

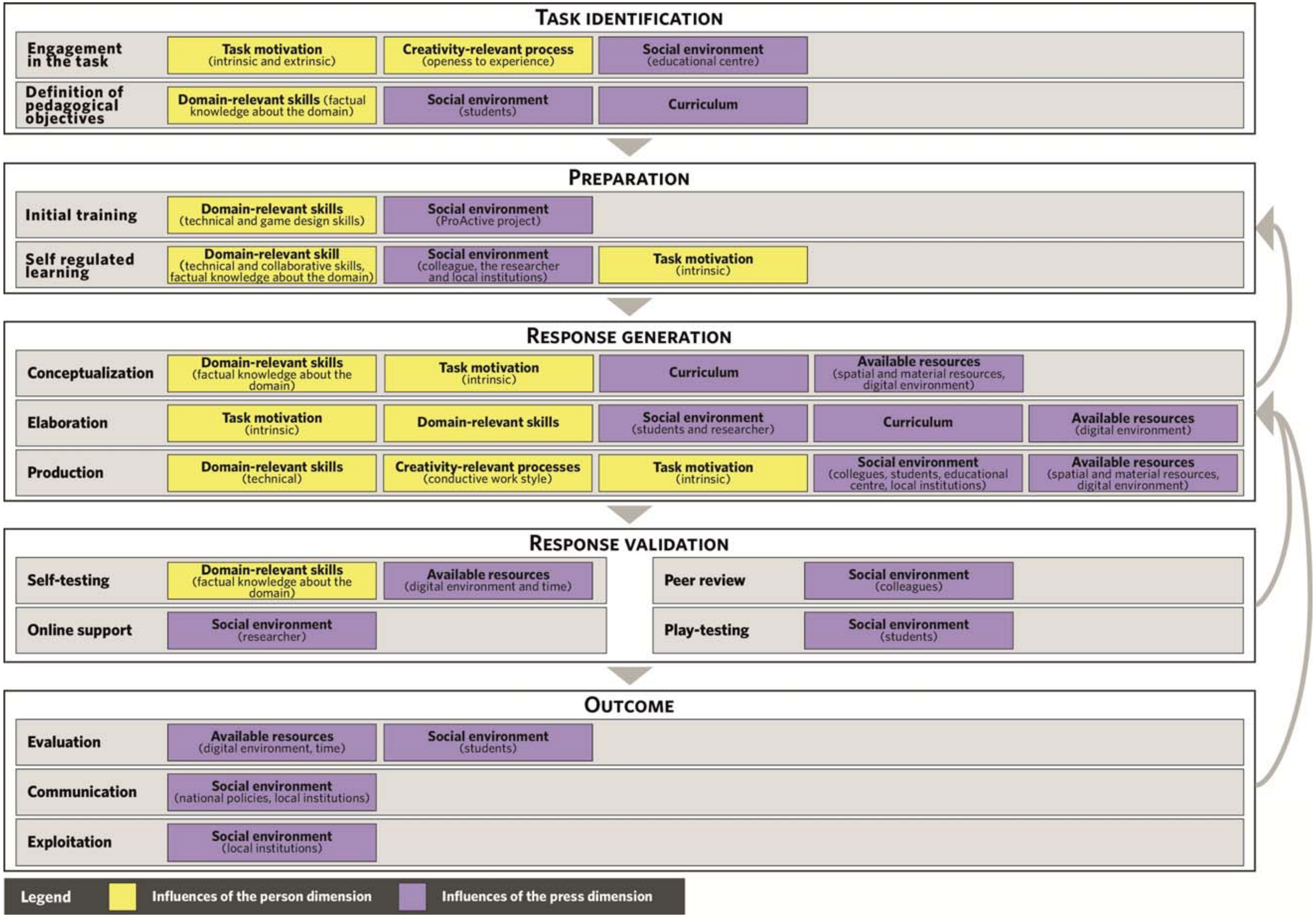

Figure 37: CEGAD - the Creative Educational GAme Design model (own elaboration)

2. Product dimension: results and findings

This section details the results regarding the product dimension. It focuses on the LGs created by teachers, according to two different criteria: (a) usefulness, i.e. up to what extent they are entertaining (gaming aspects), provide high learning achievements (pedagogical aspects), and are easy to use (usability aspects); and (b) novelty, i.e. their level of innovation from the perspectives of teachers (little-c creativity), the educational community (middle-c creativity), and the market in general (Big-C creativity). On the basis of these results, I answer the research question related to the product dimension, i.e. *to what extent are the LGs designed by teachers creative?*

2.1. Usefulness

2.1.1. Gaming aspects

In order to explore the potential of the LGs to provide entertaining experiences, I looked at five different aspects, i.e. the clarity of intermediary and final goals, the balance of difficulty, the clarity and constancy of feedback, the clarity and consistence of rules, and the presence of elements which facilitate the player's immersion. The next paragraphs describe the results highlighted by the different case studies.

a) Clear and consistent dynamics

Considering dynamics as the interactions between the system of the game and the player (clarity of intermediary and final goals, balance of difficulty, clarity and consistency of feedback), data analysis showed that the LGs created by teachers generally present clear and consistent dynamics.

First of all, teachers and experts considered the goals of the LGs to be well defined and made explicit to players. Indeed, *Alice's Trip* game includes an introductory book which explains to players what they have to do. In contrast, the other LGs include non-playable characters who inform players of the objectives they have to achieve in order to finalize the games. As a result, students clearly understood, since the beginning, what they had to do and why. This is in line with Sweetser and Wyeth's recommendation (2005), that games they should present an overriding goal early enough, in order to help players to focus on what they have to do.

In addition, feedback was generally considered to be clear and constant. In line with Kiili (2005), teachers made sure that all actions of their LGs lead to reactions, in an immediate and unambiguous manner. Experts generally agreed with this statement, arguing that the characters correctly respond to players' actions, and that all interactions lead to an adequate feedback. Hence, in line with Gee (2005), the games appeared to talk back to players, allowing for an autonomous experience. Nevertheless, experts highlighted some imperfections in the feedback system, e.g. the lack of both visual and auditive feedback, and small intervals of time between the players' actions and the game's answers. Students considered having received the necessary feedback on their actions, being well informed of their successes or failures. In line with Gee (2009), this enabled them to identify and evaluate their mistakes.

Rules were also considered to be clear and simple, so students generally knew how to play them (Rapeepisarn et al., 2008). Indeed, they require players to conduct simple actions such as taking, talking or walking, and do not change along the progression of the games. Experts outlined, nevertheless, some inconsistencies, mostly related to usability aspects. Sometimes, buttons do not lead to any effect, and the same icon has to be used in order to carry out different actions, which can confuse the player.

b) Linear dynamics which do not enhance players' engagement

Although the game dynamics mentioned above were found to be generally clear and consistent, they did not necessarily enhance players' engagement.

Indeed, the game rules were sometimes considered to be basic, repetitive and linear. For example, for Cases 1 and 4, all the scenes work on the same model. For Case 1, the game consists of a series of scenes which work on the same basis, i.e. players meets a character who ask them a question; they have to find, among three given possibilities, the right answer, in order to access the next scene. As for Case 4, each scene represents the environment of an artist, in which players have to combine objects which pertain to this artist, in order to hear one of his songs and access the next scene. In order to enhance students' engagement, the LGs should contain more varied and complex systems of rules, involving more decision making processes (Perrotta, 2013).

Although final goals were considered to be generally clear, experts suggested, in some cases, adding complementary indications and clues (Sweetser and Wyeth, 2005), in order to remind the final objective to players, thus guiding them and enhancing their motivation.

In addition, the feedback elements were often considered to be basic, and generally did not provide information on the players' progression. As mentioned by Malone and Lepper (1987) and Sweetser and Wyeth (2005), feedback about players' performance should be constant along the game. Hence, experts suggested adding more feedback elements in order to inform players on their performance, thus enhancing their engagement and motivation. For example, in line with Ulicsak & Williamson, (2011), they suggested adding a constant visible score indicating the number of right and wrong answers, time indicators, or rewards (e.g. badges). Teachers from Case 1 also recognized that the feedback system of their LG was too basic. They argued that they did not possess the sufficient skills to establish a more sophisticated system.

c) Unbalanced challenge

Although teachers generally considered the level of difficulty to be adequate in their LGs (Cases 2, 3 and 4), experts generally argued that the games are too easy to solve in comparison to the targeted students' profiles (Cases 1, 3 and 4). For instance, for Case 3, experts argued that the game guides players until they reach the final objective. As a result, players cannot be wrong or lose the game.

Furthermore, for Cases 1 and 4, the level of difficulty does not increase gradually, which does not enable students to perceive their advancement (Ulicsak & Williamson, 2011) according a scaffolding system which allows for logical learning progression (Gee, 2003).

In addition, for all cases, the level of difficulty was not personalized, in the sense that players could not vary the difficulty of the games according to their level and rhythm (Malone & Lepper, 1987; Gee, 2003). The possibility of personalization according to student's level of skills would have been time consuming, but also too complex regarding teachers' skills and the editor's affordances. Experts recognized that it would be a lot of effort of programing, which may not worth it.

More generally, experts suggested adding more elements of challenge, such as rewards, time counting, and risks to fail, in order to stimulate students' motivation.

d) Immersive environments

The immersion potential provided by the game narratives were positively valued in all cases: for Case 1, the game relates to a time travel and to the *Alice's Adventures in Wonderland* novel; for Case 3, the LG tells a story in the Celtic Galicia, which includes wizards, druids and swords; for Case 4, the game occurs in a psychedelic future world in which Rock music has to be resuscitated. In line with Sweetser and Wyeth (2005), Ulicsak and Williamson (2011), these elements appeared to match the targeted students' interests and profile, and to enhance engagement. Case 2, in contrast, was considered appealing given the proximity of the narrative to students' environment.

Furthermore, graphical elements were found to enhance players' immersion in the games' environments, through the presence of many representative details, e.g. clothes of the characters, shapes of the houses, and typical objects from the time periods (Cases 1 and 3) or the artists presented through the games (Case 4). These graphical elements appeared to connect with the pedagogical objectives addressed in the LGs. Furthermore, for Cases 1 and 3, the voices of characters, especially the voices of children, critically increased the potential of immersion and engagement of the LGs.

e) A gap between the LGs and COTS

Despite of the efforts made by teachers to provide rich and detailed environments, the quality of graphics (i.e. textures, quality of movements and richness of details) are far from the state of the art of the COTS. Furthermore, the linearity of game dynamics and the usability concerns reinforced the gap between the LGs and COTS. This gap limited the potential for engagement provided by the LGs, as students are used to play these COTS.

2.1.2. Pedagogical aspects

In order to explore the potential of the LGs to provide high learning achievements, I examined different aspects, namely the clarity of the pedagogical objectives, the connection to the curriculum and associated competences, the alignment of game play and pedagogical objectives, the appropriateness of the pedagogical objectives to the profile of the group of students, the planning of complementary activities which support learning with games, the planning of students' pedagogical evaluation methodology, the planning of the necessary resources to conduct the learning activity, and attention to diversity. The next paragraphs describe the main results outlined by the different case studies.

a) Appropriate educational goals and contents

For all cases, the LGs created by teachers address clearly defined pedagogical objectives, which are correctly solved by playing the games. Furthermore, objectives and contents appeared to match the curriculum elements they were associated with. Furthermore, for Cases 1 and 3, the LGs connect to various areas of knowledge, disciplines and age ranges, which extend their possibilities of application.

Although the objectives and contents of the LGs were generally considered to be adapted to students' profile, experts argued, for Cases 1 and 2, that they were rather superficial and could be more elaborated. Teachers stated that they wanted to introduce richer content and more complex tasks, but did not have the necessary resources (i.e. time, functionalities and technical skills) to do so.

Generally, the level of integration of game objectives with pedagogical objectives was found to be high. For example, for Case 3, players have to constantly interact with elements which teach them about the Galician Celtic culture (e.g. vocabulary, objects and characters) in order to solve the game. Hence, reaching the games' objectives involves reaching the pedagogical objectives set by teachers.

b) Meaningful planning of the GBL activities

The GBL scenarios planned by teachers present an interesting variety of complementary activities (e.g. discussion sessions and visits to museums) which enable to integrate the LGs in a meaningful educational context. The LGs were either planned to serve as activities to learn more about the topic introduced in the classroom (Cases 3 and 4), as practical activities (Case 2), or as evaluation activities (Case 1). Experts sometimes suggested detailing the activities described in the scenarios, by specifying, for example, the role of teachers in the classroom.

Only for Case 1, students' evaluation was included in the game, using as indicators the number of correct answers given by students, the time used to solve the game, and the number of times students consulted the books. The other LGs did not include any evaluation indicator, but teachers planned adapted evaluation activities around the games (e.g. discussion sessions, complementary exams, and the development, by students, of extra scenes which would complete the game) in order to assess students' knowledge. Hence, instead of systematic, objective evaluation approaches, teachers also planned more flexible strategies.

c) Valuable documentation resources

For all cases, the LGs appeared to offer valuable documentation resources, in the forms of books, pictures (e.g. the bicycle picture which displays details of each element, the clothes of characters of the ancient Galicia), themes (e.g. songs of the Rock artists) or videos (showing concerts of the artists). In Case 4, these resources are presented in a dynamic manner, i.e. videos and songs are shown to players as they interact with objects or as rewards. In contrast, experts outlined, for Cases 1, 2 and 4, that students may not pay attention to the content included in books, which display a massive amount of information in a linear way. Hence, they generally suggested presenting learning resources in a more dynamic manner (e.g. links to useful content available on the Internet).

d) Correct planning of necessary resources to conduct the learning activity

The resources necessary to the correct unwinding of the GBL activities were planned in an effective manner, and matched the contexts of use of the games. For all cases, the durations scheduled were adequate to the context of the classroom. Furthermore, the use of the games did not require any complicated resource or procedure. Indeed, eAdventure games can work from any computer, with mouse, and can be launched offline.

e) Attention to diversity: a weakly addressed criterion

Attention to diversity addresses learners who need special attention (e.g. students from different cultural contexts or with scholar difficulties).

Some of the LGs created address students' specific socio-characteristics, by connecting to topics related to their city and regions, providing both Spanish and Galician languages versions (Cases 1 and 3). Nevertheless, none of the LGs enable to adapt the level of difficulty.

This criterion was difficult to implement and hardly feasible in the context of the research project (i.e. time available, teachers' skills and characteristics of the game editor).

2.1.3. Usability aspects

In order to explore the usability aspects of the LGs created by teachers, I looked at five different criteria, i.e. easiness of use, minimization of errors and dead points, easiness of installation, compatibility, and accessibility. The next paragraphs outline the results highlighted by the different case studies.

a) Usability concerns mainly due to the editor

In spite of some small concerns (e.g. the size of the interactive zones in the LG designed by teachers from Case 2), students did not meet any significant difficulty to learn and to use the functionalities, and could finalize the games in an autonomous manner. Similarly, experts could easily use the games' functionalities. Nevertheless, they highlighted serious usability problems, which they recommended to fix in order to enhance an optimal gaming experience, i.e. the lack of help functions, the presence of icons which refer to various actions, and the presence of options which do not lead to any action. Furthermore, the interactive zones are sometimes difficult to find in the scenes, so the player has to search for them.

As a result, the functionalities are sometimes confusing, and the resolution of usability problems interfere with the achievement of the games' objectives. For Case 2, one of the experts argued that the objectives of the LG consist of solving usability concerns.

Teachers were aware of these concerns, but stressed that they could not solve them, mainly because of the specificities and the lack of functionalities provided by the game editor. Indeed, both experts and teachers argued that usability problems are due to the limitations of the editor.

b) Easiness of integration of LGs in educational contexts

From a technical point of view, the integration of the software in the classroom contexts was facilitated by the characteristics of the eAdventure game engine. Indeed, the eAdventure games appeared to be easy to install on the classrooms' computers. For all cases, both experts and teachers found the installation of the LGs easy and fast, as it did not require any complicated operation or material.

Furthermore, the compatibility aspect was found to be perfectly adequate to the context of use of the games. Indeed, eAdventure games have a SCORM standard, and Moodle is used in all institutions. One of the experts argued that games should be available for mobile, and thus recommended using HTML5 as programming language.

c) Accessibility: a weakly addressed criterion

The LGs created by teachers did not address the accessibility criterion. Indeed, they did not allow for the adaptation of the interface (i.e. to resize text and customize colours) according to players' special needs, in particular students with disabilities (Whitton, 2010). Nevertheless, games were considered to be easily usable by a wide profile of students, i.e. they work with a mouse, present big letters, and provide textual equivalents for all auditory content.

2.2. Novelty

Results showed that the LGs created by teachers are innovative regarding little-c (i.e. the originality of a person's work as regard to their previous work) and middle-c (originality for an organization or small community of people) creativity. Nevertheless, LGs were not considered to be innovative regarding the gaming and education fields, or the society in general (Big-C creativity).

Most teachers considered their LGs to be innovative in comparison to the resources they regularly use (little-c creativity): they are more visual, dynamic, and include a high variety of media. Furthermore, they contain voices and images of colleagues and students. Some of the participating teachers had previously used GBL approaches in their pedagogical practices. However, one of them mentioned that the resources he usually works with are rather behaviourist, although his LG opens a window to exploration processes.

Furthermore, the LGs were considered to be innovative regarding the resources students use on a regular basis in their schools (middle-c creativity). Indeed, GBL methodologies are not widely spread in Spanish educational centres. Hence, it was new, in teachers' institutions, to have student-centred, ICT-based resources, which use narratives and graphical elements, as well as promote active learning.

In contrast, the LGs were not found to be original regarding the education and game markets (Big-C creativity). They represent innovative resources in comparison to the typical books and slides which are available in the educational market. However, teachers and experts did not consider the games innovative in relation to some ultimate learning resources, such as mobile, tablet, and augmented reality applications. With that said, some games were considered innovative regarding the density and specificity of their educational content on particular subjects.

Finally, the LGs were not considered innovative in comparison to the games available on the market. Indeed, COTS involve sophisticated technologies, dynamics and interaction modes, based on augmented reality, touch screens and voice orders, while graphical adventure rather remind games from the 80's. On this basis, the LGs created by teachers are rather archaic.

2.3. Answering SQ2: to what extent are the LGs designed by teachers creative?

On the basis of the results highlighted above, in this section I answer to the research question related to the product dimension.

Product creativity was explored according to the criteria of usefulness (the extent to which LGs achieve their objectives, i.e. by providing an entertaining experience and reaching the pedagogical objectives planned) and novelty (the level of innovation of the LGs regarding little-c, middle-c and Big-C creativity).

The LGs created by teachers appeared to be relatively useful regarding their potential to provide entertainment and to meet the pedagogical objectives initially addressed. They were generally found to present clear and constant dynamics, but lack variety and dynamism to promote students' engagement. Furthermore, while many immersive elements and details enable players to enter the environments reflected in the games, a gap with COTS' high quality of audio-visual resources and interactions limited their potential for entertainment. As for pedagogical aspects, the LGs present appropriate pedagogical goals, contents and documentation. Furthermore, although literature highlights the difficulty of aligning games with curriculum requirements (Gros, 2007; Ulicsak & Williamson, 2011), teachers could obtain resources which perfectly match their curricular objectives. In some cases, The LGs match several areas of the curriculum, so teachers could adapt the use of the game to their contexts. Nevertheless, the pedagogical objectives supported by the games were sometimes considered to be superficial, and the contents to lack dynamism. LGs were well integrated with original complementary learning activities, thus enabling to correctly exploit their potential and evaluate students' knowledge.

It is worth reporting that teachers were aware of the weak aspects highlighted above. Nevertheless, the context of the design process (i.e. time resources, technical skills and characteristics of the game editor) did not enable them to set more elaborated dynamics, to deepen educational contents, and to fix the usability problems. Hence, product creativity appeared to be hindered by environmental constraints and teachers' lack of technical skills.

Results showed that teachers' creativity, as reflected in the produced LGs, is more related to little-c and middle-c. This is in line with the current literature on creativity and education, which stress that small levels of creativity are suitable for teaching settings (Ferrari et al., 2009b; Runco, 2003). Indeed, the games created by teachers are considered to be innovative and useful regarding their usual teaching practices and the resources that are used to create (little-c). For most of the participating teachers, it was their first opportunity to create ICT-based teaching resources centred on students and based on game principles. Furthermore, the LGs constitute innovative teaching resources for students and for the educational centres (middle-c), as GBL practices are not widely spread in schools.

In contrast, the LGs created were not considered to be innovative regarding the learning resources and games available on the market (Big-C creativity). Hence, the innovative aspect of the LGs regarding

Big-C creativity relates to the fact that teachers designed them. Indeed, the LG created by teachers from Case 1 won an international prize on innovative education.

Figure 38 resumes the main findings of the study regarding the creativity of the LGs created by teachers, as compared to the aspects explored in the product dimension (see Figure 12).

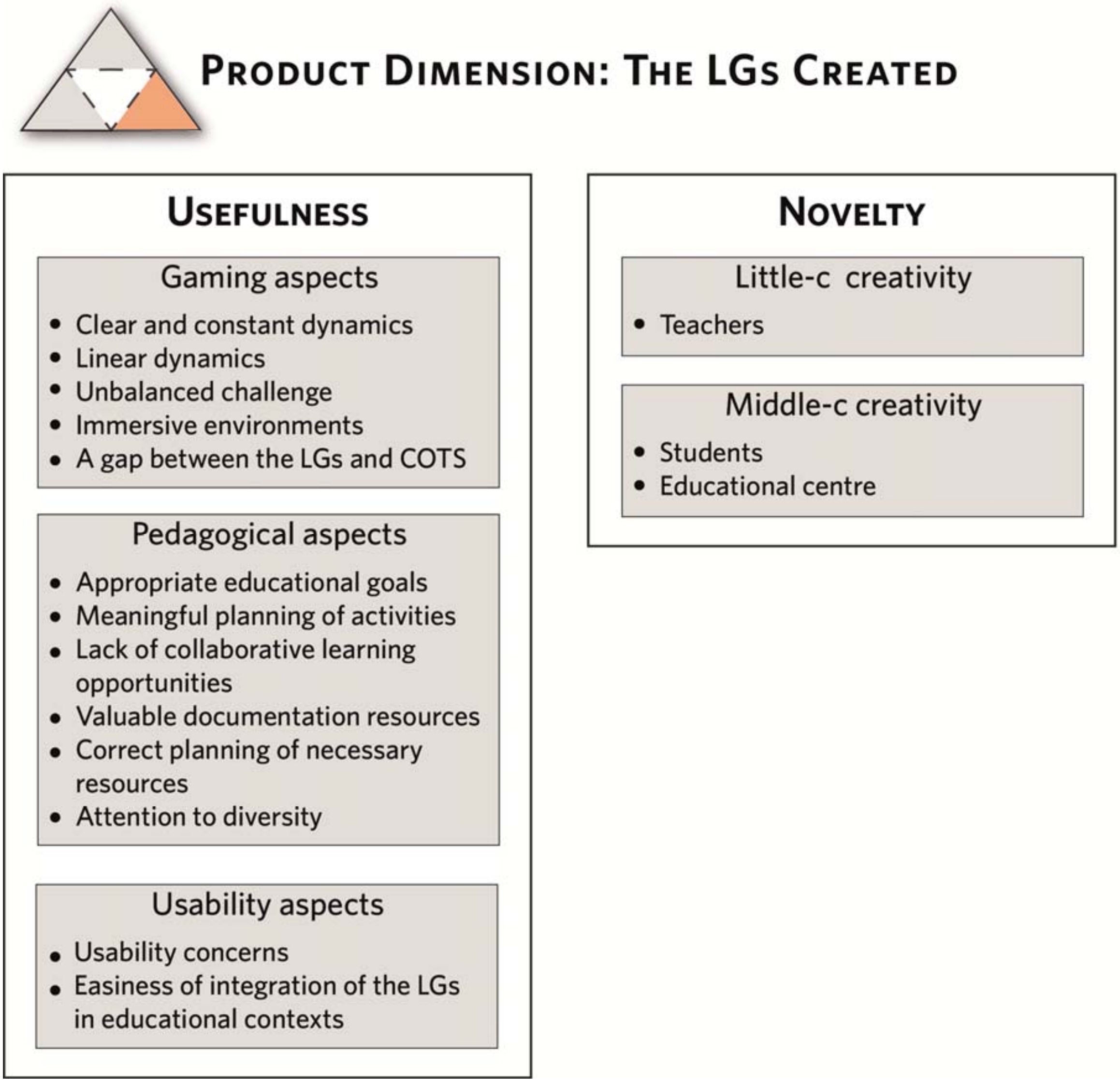

Figure 38: Results for the product dimension: usefulness and novelty of the LGs created by teachers

3. Teaching dimension: results and findings

This section discusses the results related the third dimension of creativity studied in this research, i.e. the teaching practices at stake during the application of the LGs in the classroom. To do so, it looks at both teachers' (i.e. the way they organized the GBL activities and their role during the GBL session) and students' (i.e. their level of engagement in the GBL activity) perspectives. Results relate to Cases 1, 2 and 3. Indeed, the LG created by the teacher from Case 4 was not applied with students. On the basis of results, I answer the research question related to the process dimension: *what are the teaching practices at stake during the application of LGs in the classroom, in relation to creativity?*

3.1. Teachers' experience

3.1.1. Meaningful integration of the LGs in the educational plan

Results showed that teachers did not consider the LGs as a stand-alone activity (Whitton, 2010), but as part of a learning package of activities. Indeed, they organized varied complementary activities around their games. For Case 1, the teacher who implemented the game organized visits to museums and to the sites presented through the LG, as well as discussions around the game topics. As for Case 2, the teacher used the game as a tool to reinforce elements of knowledge that students developed during a lesson and put into practice during a hands-on session. Finally, teachers from Case 3 conducted a project-based activity in which students searched about the iron-age Galicia on the Internet, as well as an outside session in which they introduced them to the local flora. In line with Whitton (2010) and Ulicsak (2010), these complementary activities were found to provide a meaningful context to the use of the LGs, and to support the pedagogical objectives addressed by teachers.

The organization of these complementary activities promoted creative teaching practices (in reference to the key-characteristics of creative pedagogies highlighted in Chapter 2, p. 32), which are described below.

a) Helping students to make connections

By organizing complementary activities around their games, teachers enabled their students to access knowledge from different sources. Indeed, by playing the LGs, students could apply elements previously learnt inside or outside the classroom in the context of the complementary activities. The LGs presented the information in a different manner and context, thus offering a new perspective towards the same content. As a result, the games fostered discussions and created doubts regarding some elements of knowledge, so students could critically analyse them towards a unified perspective.

b) Applying flexible evaluation strategies

Teachers employed different evaluation approaches in order to assess students. The teacher from Case 1 partially evaluated her students through the indicators contained in the game (i.e. number of correct answers, number of mistakes and number of times they consulted the book). Furthermore, she organized complementary exams. Finally, during the visits of the sites and museums, she asked informal questions to students to evaluate their knowledge. For Case 2, teachers organized an exam of the content addressed in the game. As for Case 3, the evaluation of students' knowledge consisted of presenting a web-based project related to the topics supported by the LG.

3.1.2. Teachers' role during the game session

Teachers' role during the game session appeared to promote creative teaching practices (in reference to the key-characteristics of creative pedagogies highlighted in Chapter 2, p. 32), which are described below.

a) Promoting self-learning

In the context of the GBL practices, teachers gave up their role of instructor for the one of facilitator. Indeed, by letting their students freely interact with the LGs, they stood back and gave them the chance to learn in an autonomous and active manner. Teachers highlighted a part of uncertainty regarding their new role in the classroom, as they had to improvise and find a balance between helping students to solve the game and letting them gain autonomy. In spite of this slight feeling of insecurity, teachers were more relaxed than in other classes, as they could easily reach students' enjoyment and concentration, and focus on enhancing learning.

b) Providing safe and trustful environments

During the game sessions, the climate of the classrooms was generally relaxed and quiet. As they were working with their own resources, teachers were more confident and could build trustful relationships with their students. Hence, they considered the classroom environment to be more pleasant for the students and for themselves, less formal and less serious than in classes with books and digital whiteboards.

3.2. Students' experience

3.2.1. Promoting students' engagement

In order to explore students' level of enjoyment during the game sessions, I looked at different indicators of flow experience, which are specific to gaming experience (Sweetser and Wyeth, 2005; Fu, Su & Yu, 2009), and which are described below.

a) Immersion

Most students were highly engaged and absorbed while playing the LGs created by their teachers. Most of the time, they argued that time passed quickly while they were playing, but could hardly forget about their environment, as they were surrounded by other students. Nevertheless, they generally remained calm and focused on the games' objectives during the whole session, and showed positive behaviours. Indeed, many of them were smiling while playing, and were surprised to discover the different elements of the games.

b) Concentration

Students were rather concentrated and silent during the game session. They focused on the games all along the activity, and solved them without showing any distracted behaviour. Non off-task activity or conversation was observed. However, some students mentioned that it was difficult to not be distracted during the game session. Indeed, the games were played in the classroom, and students were surrounded by their classmates. Hence, concentration was not as optimal as if the games would have been played at home.

c) Autonomy

Students were autonomous while playing the LGs. They naturally and rapidly learnt how to use the games' functionalities. They sometimes asked their classmates or teachers how to carry out some actions, and then could follow the games without any problem. Furthermore, in all cases, all students achieved the objectives of the LGs without requiring any support. Consequently, the GBL sessions offered students a context to learn in an autonomous manner. They could solve the games' objective according to their own rhythm. Nevertheless, some of the LGs were considered to be lineal, and guided students' actions and choices, thus leaving them a little margin of freedom.

d) Social interactions

For all cases, activities were organized so students played the games individually, each one with a laptop. As a result, students mostly solved the tasks of the games in an individual manner, and focused on the game, rather than on the collaborative aspect of the classroom. Nevertheless, students often collaborated in order to help each other's and to solve some challenges faced in the games, or usability issues.

3.2.2. Achievement of the pedagogical objectives

Students correctly achieved the pedagogical objectives addressed through the different LGs. They either learnt new elements of knowledge while playing, or applied things previously learnt in the classroom. Furthermore, they were generally motivated to learn more about the topics addressed. For Cases 1 and 3, the themes addressed through the games were multidisciplinary, so teachers could apply the games in other teaching contexts, and reach other pedagogical objectives.

3.3. Answering SQ3: what are the teaching and learning practices at stake during the application of LGs in the classroom, in relation to creativity?

On the basis of the results described above, I answer the research question related to the teaching dimension.

Results showed that teachers could successfully integrate the LGs in meaningful educational planning. They organized relevant complementary activities around their games, which enabled them to enhance the pedagogical objectives, as well as to ensure the correct assessment of students' knowledge. Furthermore, these complementary activities appeared to offer students different perspectives on the elements of knowledge presented in the games, thus helping them to make connections.

In addition, teaching with games moved teachers from the role of instructor to the one of observer of students' learning behaviours. Nevertheless, they maintained an active and dynamic attitude, by monitoring students, offering their constant support, and encouraging them towards the achievement of the games in an autonomous manner. This compromise between an observing and monitoring stance appeared to enhance students' self-learning and to promote a trustful environment in which they felt free and relaxed.

In spite of the limitations of the LGs, learning with games proved to enhance students' enjoyment. Indeed, results highlighted the presence of various indicators of the flow experience (e.g. immersion, concentration, autonomy, and social interactions). Nevertheless, these indicators only appeared in a limited manner. This is due to the properties of the games (i.e. they provided a limited level of freedom) and the organization of the classroom (i.e. students were playing in an autonomous manner, but got easily distracted by each other's).

Finally, the study revealed the potential of the research approach to overcome some of the obstacles to the integration of GBL in formal learning contexts, as mentioned in literature (Klopfer et al., 2009; Ulicsak & Williamson, 2011). Although literature argues that educators often find it difficult to integrate game sessions into the time structure of school day, the results of the study showed that a meaningful planning of the GBL activities (i.e. embedding the game activities with other educational activities) allowed for a perfect integration of the LGs with the classroom activities. Furthermore, the authors highlighted technical and logistical issues as a barrier to the successful integration of GBL practices in the classroom. Nevertheless, the characteristics of the eAdventure engine, as well as the quality of the equipment available in the centres (i.e. hardware and exploitation systems), allowed for a perfect unwinding of the GBL activities.

Figure 39 resumes the main findings of the study regarding the creativity as stake during the application of the LGs in the classroom, as compared to the aspects explored in the teaching dimension (see Figure 13).

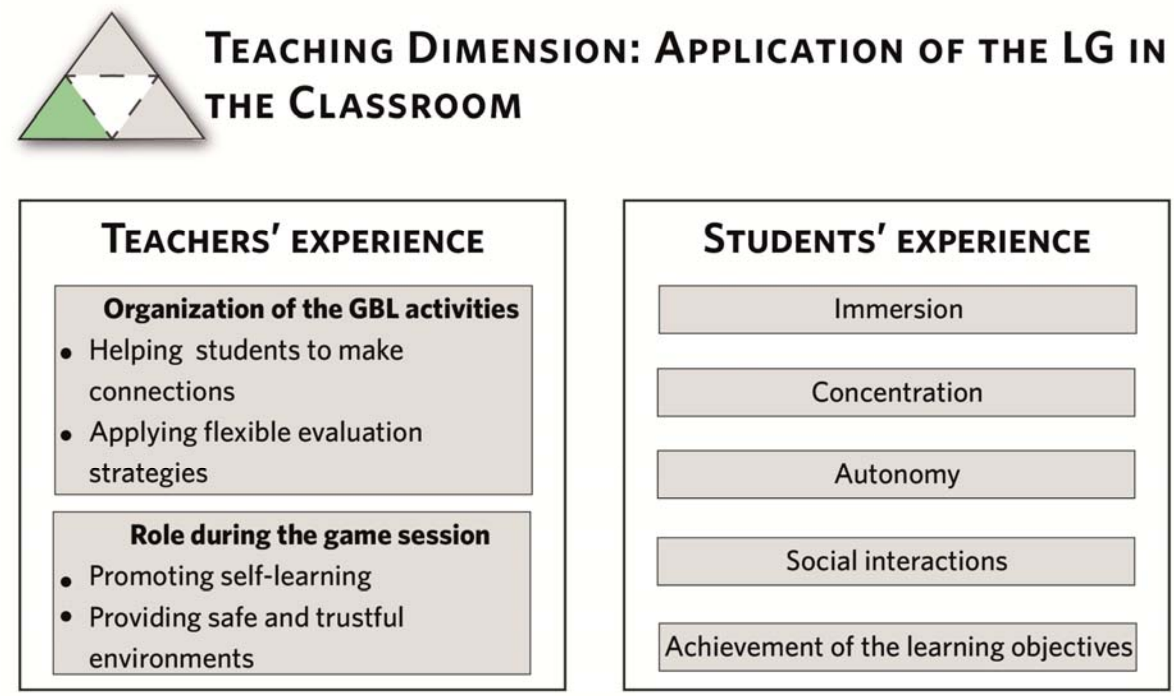

Figure 39: Results for the teaching dimension: teachers' and students' experience during the application of the LGs in the classroom

4. Teachers' creativity: answering the main research question

Now that I answered the three sub-questions, I am able to address the overarching research question of my thesis, on the basis of the findings described above:

> *How can teachers' creativity be enhanced by an approach where they design and apply their own LGs?*

In order to identify the potential of the research approach (i.e. the design and application, by teachers, of their own LGs) to enhance teachers' creativity, I examined the key-characteristics of creative pedagogies (as highlighted in Chapter 2, p. 32) at stake within educational game design (process dimension), the LGs created (product dimension) and their application in the classroom (teaching dimension). Furthermore, I incorporated some additional characteristics of creative pedagogies, which have not been mentioned in literature, but appeared in my study.

4.1. The design and application of LGs by teachers: potential to enhance creative pedagogies

On the basis of a review of literature (Amabile, 1989; Craft, 2005; Cremin et al., 2006; Cremin & Barnes, 2010; Cremin, Barnes, & Scoffham, 2009; Cremin, Burnard, & Craft, 2006; de la Torre, 1993; de la Torre, 2006a; de la Torre, 2009; de la Torre & Violant, 2003; Ferrari et al., 2009a; Ferrari et al., 2009b; Ofsted, 2010; Runco, 2003; Sawyer, 2012; Sternberg & Lubart, 1999), I highlighted a set of key-characteristics of creative pedagogies (see Chapter 2). As explained in the next paragraphs, the results of the study showed that the research approach (i.e. the design and application of LGs by teachers) enabled teachers to apply most of these characteristics.

a) Promoting learner-centred methodologies

Game design constituted, for teachers, an opportunity to centre on their students. Indeed, they decided to design their LGs in order to connect to students' interests, to obtain a resource which would be innovative and engaging to them, as well as to get closer to their culture and daily life.

During each step of the game design process, they had the opportunity to focus on students: they concentrated on topics which connect to their socio-cultural profile (e.g. their region, traditions, and daily environment), as well as created narratives and graphical environments which match their age and interests (e.g. a time travel or a medieval narrative with forts and swords). Furthermore, they adapted the difficulty of their LGs to the level of knowledge of their students.

As a result, this experience provided teachers with an opportunity to interact with their students, "to know them better", "to reach them more easily", and to "establish a better communication" (Annex 8.1.1).

Nevertheless, the LGs produced were sometimes negatively evaluated regarding the correspondence of their level of difficulty with students' profiles. This lack of balance is mainly due to teachers' difficulty to design rich game dynamics and to promote students' freedom of action with the resources available to them (i.e. time, digital skills, and the functionalities of the game editor).

b) Allowing for self-learning

Teachers' role in the classroom changed from their usual teaching practices. They moved from an active, central role of organizer, constantly leading students and giving them indications, towards an observer stance and moderating role, analysing students' behaviours, helping them to gain autonomy, to be protagonists, and to self-manage their actions. As a result, students became protagonists of the classroom and of their learning processes, by freely interacting with the game elements, without requiring the input of their teachers.

Nevertheless, some of the LGs present a limited level of freedom. Teachers recognized this lack of freedom, and attributed it to environmental constraints.

c) Helping to make connections

By providing blended learning opportunities (i.e. the game sessions, lessons and complementary learning activities outside of the classroom), teachers helped learners to apprehend knowledge from different perspectives. Hence, while playing the games, students could apply knowledge previously built in the context of different activities. As a result, they could confront different sources of information, critically evaluate them, and develop a multiple and flexible perspective towards the same element of knowledge. Consequently, teachers were able, through the LGs, to contextualize knowledge in relation to other subjects and to the world outside the classroom.

d) Promoting exploration and discovery

The LGs allowed for exploration and immersion in fictional environments. For example, the games related to the history of Galicia enabled students to explore historical environments, by walking in forts, finding representative objects, observing the shapes of houses and the way of clothing of the characters. Moreover, the LG related to the history of Rock music offered players the opportunity to discover the environments of different artists, by listening to their songs, manipulating their favourite instruments, and observing their cloth items.

If some games offer the possibility to experiment and interact with the majority of elements and objects included in their structures, some others were not considered to be sufficiently open to promote exploration and discovery.

e) Promoting engagement

The LGs designed by teachers present several elements that promote students' motivation and enjoyment. First, the proposed topics and narratives were positively valued, as they include elements of interest for the targeted students (e.g. references to their culture and to their daily environment). In addition, several audio-visual elements proved to enhance immersion and engagement, such as the use of children' voices for the characters, the music tracks and videos, as well as the pictures which illustrate students' close environment.

Nevertheless, the dynamics of some of the games were considered, in some cases, too linear and repetitive. Indeed, they could have included more interactive elements, sophisticated rules, motivating feedback elements and challenging goals, in order to provide a higher level of engagement. Although teachers mentioned that they had many ideas to potentiate engagement in their games, they had to discard many of them as they were not feasible given the resources they had available.

f) Providing a safe and trustful environment which encourages risk-taking behaviours

The GBL sessions were characterised by a relaxed and pleasant classroom environment. Students acted freely, and teachers encouraged them towards the achievement of the games. Trusting relationships among students and teachers were observed. Students appeared to be more relaxed than during a common lecture, as they could make mistakes, learn from their errors, and explore new possibilities, without feeling pressured or evaluated by their teachers.

g) Adopting flexible evaluation approaches

Teachers applied varied strategies in order to evaluate students' knowledge, i.e. assessment approaches included in the game, exams, web-based projects and informal discussions. Although assessment often appears as a challenge to the integration of games in educational contexts (Klopfer et al., 2009; Ulicsak, 2010), the study highlighted that teachers effectively assessed students' knowledge through different types of evaluation strategies (i.e. activities comprised inside or outside the game, objective tests, and flexible methodologies).

h) Encouraging collaboration

Given the affordances of the game editor, teachers designed individual games. Nevertheless, some collaborative behaviours among students were observed during the game sessions, i.e. they often helped at each other' when encountering difficulties. Furthermore, teachers planned some collaborative activities around the games (e.g. debates). Nevertheless, it is not possible to assume that the GBL activities enhanced collaborative learning. Indeed, students did not jointly solve any pedagogical objective. GBL scenarios could have included more collaborative aspects, through activities around the game, or by playing it on a digital whiteboard.

i) Relying on different sources, including ICT

Digital games offer a wide range of media. Consequently, in the game design context, teachers had the opportunity to create ICT-based teaching resources which include different types of media, i.e. graphical, audio and animated elements that students can freely manipulate.

4.2. The design and application of LGs by teachers: emerging creative pedagogies

The last section showed that the game design approach enabled to enhance many characteristics of creative pedagogies highlighted in literature. Beyond these, I highlight additional key-characteristics of creative pedagogies which have not been mentioned in literature, but emerged from the results of the study, and were confirmed by teachers' opinions. These emerging key-characteristics of creative pedagogies are discussed below.

a) Designing resources especially thought for students

The research provided teachers with the opportunity to design their own educational resources, specially tailored to their particular contexts and to the specific profile of their students. Teachers highlighted the importance of crossing the line that separates them from creating resources.

b) Integrating elements from students' environment in teaching practices

In the game design context, teachers had the opportunity to use various elements from their students' environment and culture in their teaching practices. This enabled students to locate and contextualize knowledge in familiar surroundings, which lead to meaningful learning experiences and outcomes.

c) Collaborating with stakeholders from the educational community

In order to consider students' environment, the study highlighted the importance of including, in teaching practices, different actors from the educational community, e.g. the educational centre, students, colleagues, and the local cultural institutions (including museums and city councils, colleagues and the students themselves). This inclusive approach allows for the consideration of different perspectives, which facilitates the localization of knowledge in a broader context, and its connection with other disciplines and with the outside world.

d) Teaching as an inquiry process

In order to create a complete and valid game in terms of content, some teachers proceeded to in-depth inquiry on the topic addressed in their LGs, by searching for information in the museums of the city, on the Internet, and asking to different actors from their community. This process appeared to be particularly rewarding. Indeed, it is important that teachers continuously investigate in their discipline, in order to re-evaluate and complete their knowledge on the domain, and to validate their professional expertise.

Summary of the chapter

This chapter compared the results regarding the four cases studied in the research. It highlighted the similarities and differences among cases, and provided a broad picture of results, by answering the three sub-questions addressed by the study, each of them corresponding to a research dimension, i.e. process, product and teaching. On this basis, I answered the overarching research question, by identifying the potential of the research approach to enhance teachers' creativity.

The next chapter highlights conclusions of the study, by providing final reflections on the approach, drawing its limitations, and proposing further lines of research.

Chapter 8

Conclusions and final reflections

Introduction

This study addressed the phenomenon of creativity, as applied to innovative practices in which teachers designed and applied their own LGs. Creativity was approached according to three different dimensions, namely process (educational game design), product (the LGs created) and teaching (the application of the LGs in educational contexts). In order to create a holistic picture of the experience, I used a multiple case study strategy within the methodology of qualitative research, under the constructivist-interpretive paradigm. I conducted four case studies, involving nine teachers from three different Spanish primary and secondary schools. To approach the phenomenon of creativity from different perspectives and to ensure the credibility of the research, I gathered data from different sources, i.e. interviews, questionnaires, documents and field observations in classroom settings. Furthermore, I involved different actors, i.e. teachers, students, and experts in GBL.

This chapter draws the conclusions of the study. It provides final reflections on the research approach, (i.e. the design and application of LGs by teachers), by highlighting its opportunities, good practices, and challenges. It ends with the limitations of the research, conclusions and future practices.

1. Reflections on educational game design by teachers: opportunities, facilitators and challenges

On the basis of the findings of the study, this section reflects on the research approach, i.e. the design and application, by teachers, of their own LGs. It analyses the opportunities brought by this approach, the practices which facilitated its success, as well as the challenges which made it more difficult.

1.1. Opportunities

Hereby I describe the possibilities and positive impacts which emerged from the research approach.

1.1.1. A challenging and rewarding task

The design process appeared to be a challenging experience for all teachers who participated in the study. Indeed, when they engaged in the task, most of them did not have any experience or knowledge on digital games in general, and on LGs in particular. With a high amount of time, efforts, and persistence, they progressively solved the difficulties encountered on their paths, and found their way towards achieving their objective. This challenging process was positively valued by teachers; it called to their intrinsic motivation, and facilitated the occurrence of flow state. Indeed, they found it rewarding to see their project evolving, on the fruit of their hard work, until being concretized into a working game.

1.1.2. An opportunity for professional development

With game design, teachers had the opportunity to discover an innovative and valid teaching methodology, which allowed for the achievement of their pedagogical objectives, while enhancing students' engagement. This experience opened them the door to new ideas for innovative ICT-based teaching projects. In a teacher's words, "I would not like to work without those new possibilities. It would be difficult to still work with old methodologies" (Annex 8.1.1).

In addition, game design offered teachers the opportunity to acquire a wide range of domain-relevant skills and knowledge. First, they developed technical skills, such as programing, editing pictures and audio files. They also developed different skills necessary to design a game (i.e. interaction design, graphic design, script writing and the design of game mechanics), in relation to pedagogical contexts. Finally, the game design process offered them a chance to develop expertise in their discipline. Indeed, as they elaborated educational contents and produced the resources of their games, they re-evaluated their knowledge in their discipline, researched for new elements of knowledge, and validated their professional expertise.

Collaborative game design offered teachers opportunities for professional development. Indeed, by working together towards shared objectives, they learnt how to make the best of each other's skills and experience. They also learnt from each other, by sharing skills and knowledge related to their respective disciplines, as well as developed a major flexibility, by learning how to respect each other's perspectives and work styles. Finally, they consolidated long-term collaborations, by building a common culture among members, characterized by trustful and safe relationships, thus creating work teams which could persist in the context of new educational projects. Consequently, the collaborative aspect of the design process constituted, for teachers, an opportunity for collective professional growth.

1.1.3. An opportunity to gain external recognition

Through their participation in the research, teachers developed their visibility among their educational centres, the local civic and cultural institutions, national educational communities, and the scientific community, at an international level. Teachers positively valued this opportunity for taking their designs beyond the classroom. Furthermore, for the first time, they felt that their efforts to develop innovative teaching practices were recognized, and could meet other teachers and educational actors sharing the same interest.

In addition, the game design process acted as a springboard for participating in other innovative educational projects. Indeed, on the basis of the recognition gained among the educational community, teachers gained the opportunity to take their projects further, or to engage in similar initiatives, in different contexts.

1.1.4. An effective and novel pedagogical approach

Through game design, teachers developed innovative and interactive learning resources, based on different types of media, which allowed for the achievement of their pedagogical objectives and matched the curriculum requirements. These resources were also found to connect to students' interests and environment, prompt their engagement and immersion, foster self-learning, help them to make connections, as well as provide safe and trustful classroom environments.

1.2. Good practices

I highlight in this section the main practices which facilitated the success of the game design approach.

1.2.1. Collaborative game design

Collaboration appeared as a determinant factor for the success of the design process. First, game design involves a high amount of time and efforts, and working in groups enabled to achieve results which would not have been possible by working individually. Furthermore, the diversity of teachers' profiles and domains of expertise facilitated the achievement of their LG. Indeed, each team member had different skills useful for the game design activities. Hence, teachers could distribute tasks according to their expertise, consider different insights, and confront their points of view, towards the achievement of their final outcome.

1.2.2. Involvement of the social environment

The involvement of teachers' social environment appeared to facilitate educational game design. The following actors had a determinant role on the design activities and outcomes:

- *The educational centre:* the schools' management encouraged teachers to engage in the design task. Furthermore, it offered them support all along the process, by making available the sufficient material resources and being flexible enough to enable the achievement of the different design activities.
- *Students:* by including their students in different game design activities, (i.e. elaboration, production and response validation), teachers could ensure the relevance of their LG to its target audience, and get closer to their culture and interest, thus enhancing the engaging and immersive potential of games.
- *Colleagues:* involving colleagues in the game design activities enabled teachers to obtain objective feedback and insights regarding the educational contents and dynamics of their games. Furthermore, the participation of colleagues in the production of resources enabled to extend their projects to their centres.
- *Local institutions:* involving cultural and civic institutions enabled teachers to contextualize their games in their environment, to obtain different perspectives on the elements of knowledge addressed in their LGs, as well as to get support for the production of audio-visual resources and the diffusion and exploitation of their projects.

Hence, the involvement of teachers' social environment turned game design into an inclusive, ecological process, which encompasses the actors from the educational community, and reflects their different perspectives in a single learning resource.

1.2.3. Use of custom-made audio-visual resources

Teachers had the possibility to use graphical elements available in the library of digital objects offered by the eAdventure software (i.e. ready-made characters, scenes and objects). Nevertheless, they chose to create their own audio-visual assets. They designed their resources on the basis of their close environment (e.g. spaces from their school and sites from their city). Hence, they could focus their attention on the specificities of the environments they attempted to represent in their games, and achieve graphical elements which connected with their pedagogical objectives. Finally, using voices from students for the games' characters appeared to enhance their potential for immersion and engagement.

1.2.4. Immersion in the environment reflected in the game

Some teachers made the effort to immerse in the domain addressed in their games. They researched for complementary information, inquired their environment, confronted different sources of knowledge from places and actors from the local community, until reaching a high level of details regarding the game environment. These details were reflected in the games, and enhanced their potential for immersion and learning.

1.2.5. Diffusion of the game

Dissemination among the local and national educational institutions (e.g. museums, city councils, educational associations, seminars, etc.) enabled teachers to gain recognition and visibility among the educational community. It also opened some doors to possible opportunities for taking their projects further, in the context of different initiatives.

1.2.6. Integration of the LGs in the educational planning

The adequate planning of the GBL activities appeared to be critical to achieve high pedagogical objectives. Indeed, planning complementary activities (introductory sessions, discussions, outdoor activities and adequate evaluation strategies, inside or outside the game) enabled to situate the LGs within meaningful learning contexts. Furthermore, presenting content both in the game and in other learning activities enabled students to make connections, to develop new perspectives towards the same elements of knowledge, and to promote critical learning.

1.3. Challenges

Hereby, I outline the main obstacles which appeared to interfere with the success of the game design approach.

1.3.1. A high demand of resources

a) Technology

Game design is mediated by technology. It involves an important part of programming. This aspect of the game design activities appeared to hinder teachers' creativity. Even if the programming process was facilitated by the eAdventure editor, it required a high level of technical skills and an important learning load. Consequently, teachers had to concentrate on learning how to use the editor functionalities, programming interactions and solving problems, so to achieve a functioning game. This investment of time and efforts prevented them to focus on the other aspects of game design (i.e. the elaboration of educational contents and the design of game mechanics). Furthermore, the editor's characteristics did not enable, in some cases, the realization of teachers' initial ideas.

Hence, even though teachers aimed to develop rich game dynamics and educational contents, they could not implement them with the game editor, given the amount of time, efforts and skills they would require.

b) Time and efforts

The creation of a LG requires a high amount of time and efforts. The workload involved by the design activities appeared as difficult to combine with teachers' daily activities and institutional pressures, i.e. the overloaded curriculum, other disciplines they teach, the time they spend with students, and the evaluation activities. Furthermore, the outcome of the design process (i.e. a 20 minutes learning activity) may appear derisory in comparison to the time dedicated to create it.

c) Domain-relevant skills

Apart from programming, the design of a LG involves a wide range of roles, i.e. expert in the domain, educationalist, game designer, interaction designer, graphic designer, and writer. Even when working in teams, teachers' skills did not cover all these aspects. As a result, they dedicated a high amount of time to develop their skills and acquire new ones, to be able to assume all these roles. This made the design process challenging, as they had to concentrate their efforts on learning.

1.3.2. Limitation of the LGs

As mentioned earlier, the LGs created by teachers present some limitations. Their dynamics (i.e. goals, feedback and rules) were considered to be linear, which limits their potential for engagement. Furthermore, the challenge was found to be unbalanced, i.e. the level of difficulty was often found to be too easy regarding students' profile, and did not include any progression and possibility for personalization. Furthermore, despite of teachers' effort to design rich and detailed environments, the quality of graphics and audio-visual elements are far from the state of the art of the COTs. As a result, there is a gap between the LGs designed by teachers, and COTS which students are used to play. This gap limits the potential for engagement offered by the LGs. Finally, the GBL activities planned did not promote collaborative learning processes.

As a result, the LGs created did not manage to totally overcome the current challenge faced in GBL practices, that is, to reach a balance between fun and learning.

2. Summing up

This multiple case study addressed creativity in educational settings. It provided tentative hypotheses to strengthen the knowledge base of the field of creativity. It tried to understand the place of the creative teacher, through a learner-centred, GBL methodology based on innovative technologies.

2.1. Main findings

My study highlighted the possibility to model game design activities on creativity process models. This was proved through the validation of the CEGAD (Creative Educational GAme Design) model. The model shows that educational game design consists of an iterative process, through which teachers engage in a game design task, define pedagogical objectives and develop new skills, in order to be able to conceptualise, elaborate and produce a related LG. Through various iterations, they evaluate the different game elements, until reaching a final outcome which they can apply in their teaching contexts. On this basis, teachers eventually take their project further, or undertake new ones.

The CEGAD model also shows that educational game design offers opportunities, for teachers, to apply and develop a wide range of domain-relevant skills and creativity-relevant processes, while experiencing both intrinsic and extrinsic motivation. Furthermore, educational game design appeared as a social process, in which different actors from the educational community can contribute and bring their perspectives. Collaborative game design appeared to promote dynamic processes of co-construction, in which teachers serve as resources for each other's towards the achievement of innovative resources. Hence, teachers' creativity, in the process of game design, is situated at the heart of a complex ecological system composed of interrelated personal and environmental components.

Educational game design appeared to develop teachers' professional creativity, by offering them the chance to involve students' environment in their teaching practices, collaborate with different stakeholders from the educational community, challenge their teaching habits, re-evaluate their expertise, re-think their students' way of learning, as well as include student-centred strategies intrinsic to games.

Results showed that teachers' creativity, in the context of educational game design, is more related to little-c and middle-c. Indeed, the games created by teachers appeared to be innovative and useful regarding the resources they normally use and create (little-c creativity). Furthermore, the LGs constitute innovative teaching resources for students and for the educational centres (middle-c creativity). In contrast, they did not appear to be innovative regarding the games and learning resources available on the market (Big-C creativity).

In spite of the limitations of the LGs produced by teachers, their adequate integration in the context of meaningful classroom activities enabled to achieve the pedagogical objectives addressed, as well as promote rich learning processes and enhance students' engagement.

2.2. Contribution of the research

My study implemented and validated an innovative approach through which teachers designed and applied their own LGs. It tested the potential of this approach to promote creative pedagogies, as well as outlined its opportunities and challenges.

Furthermore, my thesis contributed to bridging the gap between the creativity and GBL research bodies, by providing a model for creative educational game design (CEGAD), which maps game design activities on creativity models. It also represents the influences of the personal and environmental components, from the perspective of creativity.

In addition, for the educational research community, my study provided the Triforce model, i.e. a model of analysis for studying teachers' creativity from different perspectives, i.e. the process of creation of teaching resources, the resources created, and their application in the classroom.

The thesis identified, on the basis of recent literature, a set of key-characteristics of creative pedagogies, as well as brought out new ones, which are specifically relevant to the context of educational game design.

Finally, the study provided a series of data collection instruments which have been tested and validated in real settings. Among others, it provided a set of guidelines and evaluation criteria for the design of LGs.

By examining multiple cases in various school contexts, the study enabled to better understand the place of creativity in education and in game design methodologies.

For educational practitioners, my dissertation contributed to integrating creativity in formal education systems, by providing concrete examples of creative teaching practices, based on learner-centred innovative approaches in which teachers designed their own educational resources.

2.3. Limits of the research

This research presented various types of challenges. First of all, the topic of creativity is particularly difficult to apprehend, given the variety of perspectives related to its study. Indeed, creativity is a multifaceted phenomenon, and its understanding requires combining multiple approaches. To investigate the creativity phenomenon in relation to the GBL body of research, I had to build various exploratory instruments in order to achieve reliable scientific data collection strategies. By giving advantage to the link between creativity and game design, I placed less emphasis on instructional design and on the pedagogical strategies used by teachers for the design of the LGs. Nevertheless, I addressed this aspect pragmatically, through my analysis of the characteristics of creative pedagogies.

In addition, as demonstrated in my study, the creation of LGs involves a wide range of skills. When training teachers to these different skills, an emphasis was given to digital skills, i.e. the functionalities of the eAdventure editor. Indeed, learning how to use the software involves a high amount of time and efforts. The training also provided teachers with basic concepts related to game dynamics, and to the way of integrating pedagogical objectives into games. However, these aspects were given less attention than technical ones.

2.4. Suggestions for further research

The implemented approach to creativity opened teachers to innovative, learner-centred methodologies, by breaking their fear to create and apply their own interactive resources. The approach appeared to allow for a good integration of GBL activities in teaching contexts. Nevertheless, game design proved to not be totally compatible with teaching practices. Indeed, teachers had to give a lot of importance to the feasibility constraints imposed by their external environment (i.e. the time available and the editor's functionalities), to the detriment of the creativity of their ideas (i.e. their originality, relevance to the domain, and potential for engagement). I consider the whole experience as an introduction to GBL for teachers. It enabled them to get familiar with what a game is, and with game design methodologies. As for the teacher who had previous experience with games and technologies, he could concentrate in gaming aspects, and in the integration of pedagogical strategies into his game. Hence, for most cases, my research enabled to overcome a first barrier, the one of teachers losing the fear of creating interactive, learner-centred resources.

A further step would consist of involving teachers in a second implementation phase, in which they would be able to be critical towards the best way of using digital games in their teaching practices. They would be able, according to their specific educational contexts, to select the adequate way of creating their LGs (e.g. by involving their students or by choosing a different editor), design a relevant product (e.g. selecting the right game genre, and including engaging game dynamics), and develop creative activities during the game sessions (e.g. integrating collaborative activities).

Although my dissertation described the processes at stake within collaborative game design, it could not explore, in depth, the differences among individual and collaborative creativity. Future investigations could further explore this aspect, and proceed to the necessary adaptations of the CEGAD model.

Future practices may also include new case studies involving the organization of larger scale game design practices, involving the collaboration among different educational centres, a high amount of teachers from different disciplines, and with diverse skills. In addition, the collaboration among teachers and students in common projects may be an interesting aspect to research in the field of creativity applied to education.

In addition, my study focused in adventure games. New game genres and technologies could be explored, which are more innovative, such as augmented reality and *in situ* learning activities which involve collaboration among students. Gamification could be investigated as a possible alternative to game design. Indeed, this strategy relies on using techniques and mechanisms derived from games, without requiring the design of a proper game. It would enable teachers to concentrate their attention on game principles, without having to focus on technical aspects.

Finally, further studies may focus on the impact of the research approach on students' creativity, i.e. the acquisition of creative skills, which are critical in our changing information society.

Capítulo 8

Conclusiones y reflexiones finales

Introducción

Este estudio abordó el fenómeno de la creatividad, tal como se aplica en las prácticas innovadoras en las cuales los profesores diseñan y aplican sus propios videojuegos educativos. La creatividad se ha estudiado según tres dimensiones distintas, es decir, proceso (el diseño de videojuegos educativos), producto (los videojuegos educativos creados) y enseñanza (la aplicación de los videojuegos en contextos educativos). Con el fin de crear una imagen holística de la experiencia, he utilizado una estrategia de estudio de casos múltiples, en una metodología de investigación cualitativa, bajo el paradigma constructivista-interpretativo. He realizado cuatro estudios de caso, implicando a nueve profesores de tres diferentes escuelas primarias y secundarias españolas. Para abordar el fenómeno de la creatividad desde distintas perspectivas y garantizar la credibilidad de la investigación, he recogido datos de varias fuentes, a saber, entrevistas, cuestionarios, documentos y observaciones de campo en el aula. Además, he involucrado a diferentes actores, es decir, profesores, estudiantes y expertos en metodologías de aprendizaje basado en juegos.

Este capítulo describe las conclusiones de mi estudio. Ofrece reflexiones finales sobre el enfoque de investigación (el diseño y la aplicación de videojuegos educativos por el profesorado), destacando sus oportunidades, buenas prácticas y retos propios. Termina presentando las limitaciones de la investigación, conclusiones y futuras prácticas.

1. Reflexiones sobre el diseño de videojuegos educativos por el profesorado: oportunidades, facilitadores y retos

En base a los resultados del estudio, esta sección reflexiona sobre el enfoque de la investigación, es decir, el diseño y la aplicación, por el profesorado, de sus propios videojuegos educativos. Analiza las oportunidades que ofrece este enfoque, las prácticas que facilitaron su éxito, así como los retos que lo han dificultado.

1.1. Oportunidades

Aquí describo las posibilidades y los impactos positivos que derivaron del enfoque de la investigación.

1.1.1. Una tarea retadora y gratificante

El proceso de diseño ha sido un reto para todos los profesores que participaron en el estudio. En efecto, cuando se involucraron en la tarea, la mayoría de ellos no tenía ninguna experiencia o conocimiento sobre los videojuegos en general, y sobre los videojuegos educativos en particular. Con una gran cantidad de tiempo, esfuerzo y persistencia, resolvieron progresivamente las dificultades que encontraron en su camino, y hallaron su dirección para lograr su objetivo. Este difícil proceso se valoró positivamente por los profesores; facilitó el desarrollo de su motivación intrínseca y el suceso del estado de flujo (*flow*). En efecto, consideraron muy gratificante que el fruto de arduo trabajo permitiera ver su proyecto evolucionar hasta concretarse en un juego que funcionase.

1.1.2. Una oportunidad para el desarrollo profesional

Con el diseño de videojuegos, los profesores tuvieron la oportunidad de descubrir una metodología de enseñanza innovadora y válida, que les permitió alcanzar sus objetivos pedagógicos y desarrollar la motivación de sus estudiantes. Esta experiencia les abrió puertas a nuevas ideas para proyectos de enseñanza innovadores basados en las TIC. En las palabras de una profesora, "no me gustaría trabajar sin esas nuevas posibilidades. Sería difícil seguir trabajando con métodos antiguos" (Anexo 8.1.1).

Además, el diseño de videojuegos ofreció al profesorado una oportunidad para adquirir una amplia gama de habilidades y conocimientos en dominios relevantes. En primer lugar, desarrollaron habilidades técnicas, como la programación, la edición de fotos y de archivos de sonido. También desarrollaron diferentes competencias necesarias para diseñar un juego (es decir, diseño de interacción, diseño gráfico, redacción de guiones y diseño de mecánicas de juego), en relación a los contextos pedagógicos. Por último, el proceso de diseño les permitió adquirir experiencia en su disciplina. En efecto, a medida que elaboraban los contenidos educativos y producían los recursos de sus juegos, volvieron a evaluar sus conocimientos en su disciplina, investigar nuevos elementos de conocimiento, y validar su *expertise* profesional.

Por otra parte, el diseño colaborativo ofreció al profesorado oportunidades para su desarrollo profesional. En efecto, al trabajar en equipos hacia objetivos comunes, aprendieron a sacar lo mejor de las habilidades y la experiencia de cada uno. También aprendieron los unos de los otros, compartiendo competencias y conocimientos relacionados con sus disciplinas respectivas, así como desarrollaron una flexibilidad mayor, aprendiendo a respetar los puntos de vista y estilos de trabajo de cada uno. Por último, consolidaron colaboraciones a largo plazo, mediante la construcción de una cultura común entre los profesores, caracterizada por relaciones seguras y de confianza, así creando equipos de trabajo que pueden persistir en el contexto de nuevos proyectos educativos. En consecuencia, el aspecto colaborativo del proceso de diseño constituyó, para el profesorado, una oportunidad de crecimiento profesional colectivo.

1.1.3. Una oportunidad para ganar reconocimiento externo

A través de su participación en la investigación, los profesores desarrollaron su visibilidad entre sus centros educativos, las instituciones cívicas y culturales locales, las comunidades educativas nacionales y la comunidad científica, a nivel internacional. Los profesores valoraron positivamente esta oportunidad de llevar sus diseños más allá del aula. Además, por primera vez, sintieron que fueron reconocidos sus esfuerzos para desarrollar prácticas de enseñanza innovadoras, y pudieron conocer a otros profesores y actores educativos que comparten el mismo interés.

Además, el proceso de diseño de videojuego actuó como un trampolín para participar en otros proyectos educativos innovadores. En efecto, en base al reconocimiento ganado en la comunidad educativa, los profesores pudieron llevar sus proyectos más allá, o participar en iniciativas similares, en diferentes contextos.

1.1.4. Un enfoque pedagógico efectivo y nuevo

Mediante el diseño de videojuegos, los profesores desarrollaron recursos de aprendizaje innovadores e interactivos, basados en diferentes tipos de medios, que les permitieron alcanzar sus objetivos pedagógicos y cumplir con los requisitos del currículo. Además, resultó que estos recursos conectaron con los intereses y el entorno de los estudiantes, desarrollaron su motivación y su inmersión, fomentaron procesos de auto-aprendizaje, les ayudaron a hacer conexiones, así como proporcionaron entornos seguros y de confianza en el aula.

1.2. Buenas prácticas

En este apartado, destaco las principales prácticas que facilitaron el éxito del enfoque de diseño de videojuegos educativos por el profesorado.

1.2.1. Diseño colaborativo

La colaboración resultó como un factor determinante para el éxito del proceso de diseño. En primer lugar, el diseño de videojuegos requiere una gran cantidad de tiempo y esfuerzo, y el trabajo en grupos permitió lograr resultados que no hubieran sido posibles mediante el trabajo individual. Por otra parte, la diversidad de perfiles y dominios de *expertise* de los profesores facilitó el logro de sus videojuegos educativos. En efecto, cada miembro de los equipos tenía diferentes habilidades útiles para las actividades de diseño. Por lo tanto, los profesores pudieron distribuir las tareas de acuerdo a su experiencia, considerar diferentes perspectivas, y confrontar sus puntos de vista, para alcanzar su resultado final.

1.2.2. Implicación del entorno social

La participación del entorno social del profesorado facilitó el proceso de diseño. Los siguientes actores tuvieron un papel determinante en las actividades de diseño y sus resultados:

- *Los centros educativos:* la dirección de las escuelas animó a los profesores a participar en la tarea de diseño. Además, les ofreció su apoyo a lo largo del proceso, poniendo a su disposición los recursos materiales necesarios y siendo lo suficientemente flexible como para permitir la realización de las diferentes actividades de diseño.
- *Estudiantes:* mediante la inclusión de los alumnos en las diferentes actividades de diseño (es decir, la elaboración, producción y validación de respuesta), los profesores han podido garantizar la adecuación de sus juegos a su público objetivo, y acercarse a la cultura e intereses del alumnado, aumentando así el potencial de atracción e inmersión de los juegos.
- *Compañeros profesores:* la participación de sus compañeros en las actividades de diseño de juegos permitió a los profesores obtener información y perspectivas objetivas hacia los contenidos educativos y las dinámicas de sus juegos. Además, la participación de los compañeros en la producción de recursos permitió extender sus proyectos a sus centros.
- *Instituciones locales:* la participación de instituciones culturales y cívicas permitió a los profesores contextualizar sus juegos en su entorno, obtener diferentes perspectivas sobre los

elementos de conocimiento abordados en sus juegos, así como obtener apoyo para la producción de recursos audiovisuales, la difusión y la explotación de sus proyectos.

Por lo tanto, la implicación del entorno social del profesorado convirtió el diseño de videojuegos en un proceso ecológico inclusivo, que abarcó a los actores de la comunidad educativa, y reflejó sus diferentes perspectivas en un solo recurso de aprendizaje.

1.2.3. Creación de recursos audio-visuales propios

Los profesores tenían la posibilidad de utilizar elementos gráficos disponibles en la biblioteca de objetos digitales que ofrece el software eAdventure (es decir, personajes, escenas y objetos ya hechos). Sin embargo, optaron por crear sus propios elementos audiovisuales. Diseñaron sus recursos basándose en su entorno más cercano (por ejemplo, los espacios de su escuela y los sitios de su ciudad). Por lo tanto, han podido centrar su atención en las características específicas de los entornos que trataron de representar en sus juegos, y crear elementos gráficos que conectaban con sus objetivos pedagógicos. Por último, el uso de las voces de los estudiantes para los personajes de los juegos aumentó su potencial de inmersión y motivación.

1.2.4. Inmersión en los entornos reflejados en los juegos

Algunos profesores hicieron el esfuerzo de sumergirse en los dominios abordados en sus juegos. Investigaron para obtener información complementaria, indagaron en su entorno, confrontaron diferentes fuentes de conocimiento desde lugares y actores de la comunidad local, hasta alcanzar un alto nivel de detalles sobre los entornos de sus juegos. Estos detalles se reflejaron en los juegos, y mejoraron sus posibilidades de inmersión y aprendizaje.

1.2.5. Difusión de los juegos

La difusión entre las instituciones educativas locales y nacionales (por ejemplo, museos, ayuntamientos, asociaciones educativas, seminarios, etc.) permitió a los maestros obtener reconocimiento y visibilidad entre la comunidad educativa. También abrió algunas puertas a posibles oportunidades para extender sus proyectos en el marco de diferentes iniciativas.

1.2.6. Integración de los videojuegos en la planificación educativa

La planificación adecuada de las actividades de juego ha sido fundamental para alcanzar los objetivos pedagógicos planteados. En efecto, la planificación de actividades complementarias (sesiones introductorias, debates, actividades al aire libre y estrategias de evaluación adecuadas, dentro o fuera del juego) permitió situar los videojuegos en contextos de aprendizaje significativos. Además, la presentación de contenidos en el juego y en otras actividades de aprendizaje permitió a los estudiantes hacer conexiones, desarrollar nuevas perspectivas hacia los mismos elementos de conocimiento, y promover procesos de aprendizaje crítico.

1.3. Retos

Aquí describo los principales obstáculos que interfirieron en el éxito del enfoque de diseño de videojuegos por profesores.

1.3.1. Una alta demanda de recursos

a) Tecnología

El diseño de videojuegos está mediado por las tecnologías. Implica una parte importante de programación. Este aspecto de las actividades de diseño ha obstaculizado la creatividad del profesorado. Aunque el proceso de programación ha sido facilitado por el editor eAdventure, ha requerido un alto nivel de conocimientos técnicos y una importante carga de aprendizaje. En consecuencia, los profesores tuvieron que concentrarse en aprender cómo utilizar las funcionalidades del editor, programar interacciones y resolver problemas, para conseguir un juego que funcionase. Esta inversión de tiempo y esfuerzos impidió que se centraran en los otros aspectos del diseño de videojuegos (es decir, la elaboración de los contenidos educativos y el diseño de mecánicas de juego). Además, las características del editor no permitieron, en algunos casos, la realización de las ideas iniciales de los profesores.

Por lo tanto, a pesar de que los profesores querían desarrollar ricas dinámicas de juego y contenidos educativos, no los han podido poner en práctica con el editor de juego, dada la cantidad de tiempo, esfuerzos y habilidades requeridas.

b) Tiempo y esfuerzo

La creación de un videojuego educativo requiere una gran cantidad de tiempo y esfuerzos. La carga de trabajo de las actividades de diseño ha resultado difícil de combinar con las actividades diarias de los profesores y las presiones institucionales, es decir, un currículo sobrecargado, las otras disciplinas que enseñan, el tiempo que pasan con los estudiantes, y las actividades de evaluación. Además, el resultado del proceso de diseño (una actividad de aprendizaje de 20 minutos) puede parecer irrisoria en comparación con el tiempo dedicado para crearlo.

c) Competencias en el dominio

Además de la programación, el diseño de un videojuego educativo incluye una amplia gama de roles, a saber, el experto en el dominio, el diseñador de juegos, el educador, el diseñador de interacciones, el diseñador gráfico y el guionista. Incluso cuando se trabaja en equipo, las competencias de los profesores no cubren la totalidad de estos aspectos. Como resultado, dedicaron una gran cantidad de tiempo para desarrollar sus habilidades y adquirir otras nuevas, con el fin de poder asumir todos estos roles. Esto convirtió el diseño en un proceso retador, ya que tenían que concentrar sus esfuerzos en el aprendizaje.

1.3.2. Limitaciones de los videojuegos educativos

Como se mencionó anteriormente, los videojuegos creados por los profesores presentan algunas limitaciones. Sus dinámicas (es decir, los objetivos, el *feedback* y las reglas) se consideraron lineales, lo que limita sus posibilidades de motivación. Además, los juegos presentan, en muchos casos, un nivel de dificultad desequilibrado, es decir, demasiado fácil en cuanto al perfil de los estudiantes, y sin ninguna progresión o posibilidad de personalización. A pesar del esfuerzo de los profesores para diseñar entornos ricos y detallados, la calidad de los elementos gráficos y audiovisuales están lejos del estado del arte de los juegos comerciales. Como resultado, existe una brecha entre los videojuegos diseñados por los profesores y los juegos comerciales que utilizan los estudiantes habitualmente. Esta brecha limita el potencial motivacional ofrecido por los videojuegos educativos. Por último, las actividades de juego planificadas no promovieron procesos de aprendizaje colaborativo.

Como resultado, los videojuegos creados no resolvieron totalmente el reto actual propio de las prácticas de aprendizaje basado en juegos, es decir, el alcance de un equilibrio entre la diversión y el aprendizaje.

2. En resumen

Este estudio de casos múltiples abordó el tema de la creatividad en contextos educativos. Proporcionó hipótesis tentativas para fortalecer la base de conocimientos en el campo de la creatividad. Trató de entender el lugar del profesor creativo, a través de una metodología de aprendizaje basada en juegos, centrada en el alumnado, y basada en tecnologías innovadoras.

2.1. Mayores descubrimientos

Mi estudio ha puesto de manifiesto la posibilidad de aplicar actividades de diseño de videojuegos en modelos del proceso creativo. Esto se demostró a través de la validación del modelo CEGAD (Creative Educational GAme Design - diseño creativo de juegos educativos). El modelo muestra que el diseño de videojuegos educativos consiste en un proceso iterativo, en el cual los profesores se involucran en la tarea de diseño, definen objetivos pedagógicos, desarrollan nuevas habilidades, con el fin de ser capaces de conceptualizar, elaborar y producir un videojuego educativo. A través de varias iteraciones, se evalúan los diferentes elementos del juego, hasta llegar a un resultado final que se puede aplicar en sus contextos de enseñanza. Sobre esta base, los profesores llevan sus proyectos más allá, o empiezan con otros.

El modelo CEGAD también muestra que el proceso de diseño de videojuegos ofrece oportunidades, para el profesorado, de aplicar y desarrollar una amplia gama de habilidades y procesos relevantes para la creatividad, experimentando ciertos aspectos de motivación intrínseca y extrínseca al mismo tiempo. Además, el diseño de videojuegos educativos apareció como un proceso social, en el cual diferentes actores de la comunidad educativa pueden contribuir y aportar sus puntos de vista. El diseño colaborativo promovió procesos dinámicos de co-construcción, en los cuales los profesores sirvieron como recursos los unos para los otros, para alcanzar recursos innovadores. Por lo tanto, la creatividad docente, en el proceso de diseño de videojuegos educativos, se sitúa en el corazón de un sistema ecológico complejo compuesto de componentes personales y de entornos interrelacionados.

El diseño de videojuegos educativos permitió a los profesionales desarrollar su creatividad profesional, ofreciéndoles la oportunidad de involucrar al entorno de sus estudiantes en sus prácticas de enseñanza, colaborar con diferentes actores de la comunidad educativa, cuestionar sus hábitos de enseñanza, reevaluar su experiencia, repensar el aprendizaje, y poner en práctica estrategias centradas en el estudiante.

Los resultados mostraron que la creatividad de los profesores, como se refleja en los videojuegos producidos, se relaciona con *little-c* y *middle-c*. En efecto, los juegos creados por los profesores se consideraron innovadores y útiles en cuanto a sus prácticas docentes habituales (*little-c*). Por otra parte, constituyen recursos didácticos innovadores para sus estudiantes y para sus centros educativos (*middle-c*). Sin embargo, los videojuegos creados no se consideraron innovadores con respecto a los recursos de aprendizaje y juegos disponibles en el mercado (*Big-C*).

A pesar de las limitaciones de los videojuegos educativos producidos por los profesores, su adecuada integración en el contexto de actividades significativas en el aula permitieron alcanzar los objetivos pedagógicos planteados, así como promover procesos de aprendizaje ricos y potenciar la motivación de los estudiantes.

2.2. Aportaciones de la investigación

Mi tesis ha implementado y validado un enfoque innovador a través del cual el profesorado diseña y aplica en el aula sus propios videojuegos educativos. La investigación ha puesto a prueba el potencial de este enfoque para promover pedagogías creativas, destacando sus oportunidades, facilitadores y retos.

En segundo lugar, la tesis ha contribuido a cerrar la brecha entre las áreas de investigación de creatividad y de aprendizaje basado en juegos, proporcionando un modelo para el diseño creativo de videojuegos educativos (CEGAD - Creative Educational GAme Design), que aplica las actividades de diseño de videojuegos en los modelos de creatividad. También representa las influencias de los componentes personales y del entorno, desde una perspectiva de creatividad.

Además, para la comunidad científica, mi estudio proporcionó el modelo Triforce, es decir, un modelo de análisis para el estudio de la creatividad del profesorado desde diferentes perspectivas, a saber, el proceso de creación de recursos pedagógicos, los recursos creados, y su aplicación en el aula.

La tesis identificó, en base a la literatura reciente, un conjunto de características clave de las pedagogías creativas, así como aportó otras nuevas, que son especialmente relevantes para el contexto de diseño de videojuegos educativos.

Por último, el estudio proporcionó una serie de instrumentos de recogida de datos, que han sido probados y validados en contextos reales. Entre otros, se proporcionó un conjunto de directrices y criterios de evaluación para el diseño de videojuegos educativos.

Al examinar varios casos en diversos contextos escolares, el estudio permitió entender mejor la posición de la creatividad en la educación y en las metodologías de diseño de juegos.

Para profesionales de la educación, mi tesis contribuyó a la integración de la creatividad en los sistemas educativos formales, proporcionando ejemplos concretos de prácticas pedagógicas creativas, basadas en enfoques innovadores centrados en el alumno, en el cual los profesores diseñan sus propios recursos educativos.

2.3. Limitaciones de la investigación

Esta investigación presentó distintos tipos de obstáculos. En primer lugar, el tema de la creatividad es particularmente difícil de abordar, dada la variedad de perspectivas relacionadas con su estudio. En efecto, la creatividad es un fenómeno multifacético, y su comprensión requiere de la combinación de múltiples enfoques. Para investigar el fenómeno de creatividad en relación con el área de investigación de aprendizaje basado en juegos, he tenido que construir diversos instrumentos de exploración con el fin de lograr estrategias científicas de recogida de datos fiables. Al dar ventaja a la relación entre la creatividad y el diseño del juego, puse menos énfasis en el diseño instructivo y las estrategias pedagógicas utilizadas por el profesorado en el diseño de sus videojuegos educativos. Sin embargo, me dirigí a este aspecto pragmáticamente, a través de mi análisis de las características de las pedagogías creativas.

Además, como se ha demostrado en mi estudio, la creación de videojuegos educativos implica una amplia gama de competencias. Cuando formé a los profesores a estas diferentes habilidades, di énfasis a las habilidades digitales, es decir, las funcionalidades del editor eAdventure. En efecto, aprender a usar este programa implica una gran cantidad de tiempo y esfuerzos. La formación también informó a los profesores sobre los conceptos básicos relacionados con las dinámicas de juego, y la forma de integrar los objetivos pedagógicos en los juegos. Sin embargo, he prestado menos atención a estos aspectos que a los aspectos técnicos.

2.4. Sugerencias para futuras investigaciones

El enfoque implementado hacia la creatividad abrió los profesores a metodologías innovadoras y centradas en el alumno, rompiendo su miedo a crear y aplicar sus propios recursos interactivos.

El enfoque permitió una buena integración de las actividades de juego en contextos de enseñanza. Sin embargo, el diseño del juego resultó no ser totalmente compatible con las prácticas de enseñanza. En efecto, los profesores tuvieron que dar mucha importancia a las restricciones de factibilidad impuestas por su entorno externo (es decir, el tiempo disponible y las funcionalidades del editor), en detrimento de la creatividad de sus ideas (es decir, su originalidad, relevancia para el dominio y potencial para la motivación). Considero esta experiencia como una introducción, para el profesorado, a prácticas de aprendizaje basado en juegos. Les permitió familiarizarse con los videojuegos educativos, y con las metodologías de diseño de juegos. En cuanto al profesor que tenía experiencia previa con videojuegos y tecnologías, ha podido concentrarse en los aspectos del juego y en la integración de las estrategias pedagógicas en su juego. Por lo tanto, para la mayoría de los casos, mi investigación permitió superar una primera barrera, la de los profesores que pierden el miedo a la creación de recursos interactivos centrados en el alumno.

Próximos pasos, para continuar esta investigación en el futuro, podrían consistir en realizar una segunda fase de implementación, en la que el profesorado podría ser crítico hacia la mejor manera de utilizar los videojuegos digitales en sus prácticas de enseñanza. En función de sus contextos educativos específicos, podrían seleccionar la forma más adecuada para crear sus videojuegos educativos (por ejemplo, mediante la participación de sus estudiantes o eligiendo un editor diferente), diseñar un producto relevante (por ejemplo, seleccionando el género de juego adecuado, e incluyendo dinámicas de juego motivadoras), y desarrollar actividades creativas durante las sesiones de juego (por ejemplo, integrando actividades colaborativas).

Aunque mi tesis ha descrito los procesos colaborativos en el diseño de videojuegos, no ha podido estudiar, en profundidad, las diferencias entre la creatividad individual y colaborativa. Futuras investigaciones podrían explorar más a fondo este aspecto, y proceder a las adaptaciones necesarias del modelo CEGAD.

Futuras prácticas también pueden incluir nuevos estudios de caso abordando la organización de actividades de diseño de juegos a mayor escala, implicando la colaboración entre diferentes centros educativos y una gran cantidad de maestros de disciplinas diferentes y con competencias diversas. Además, la colaboración entre los profesores y estudiantes en proyectos comunes puede ser un aspecto interesante para investigar en el campo de la creatividad aplicada a la educación. Por otra parte, mi estudio se centró en juegos de aventura. Nuevos géneros y tecnologías de juego se podrían explorar, que son más innovadores, como la realidad aumentada y las actividades de aprendizaje *in situ*, que implican la colaboración entre los estudiantes. También se podría investigar *gamification* como una posible alternativa para el diseño de juegos. En efecto, esta estrategia se basa en el uso de técnicas y mecanismos derivados de juegos, sin que sea necesario el diseño de un propio juego. Permitiría al profesorado concentrar su atención en los principios de juego, sin tener que centrarse en los aspectos técnicos.

Finalmente, futuras investigaciones se podrían centrar en el impacto del enfoque de investigación sobre la creatividad de los estudiantes, es decir, la adquisición y consolidación de habilidades creativas, que son fundamentales en la cambiante sociedad de la información.

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