PONTIFICIA UNIVERSIDAD CATOLICA DE CHILE
SCHOOL OF ENGINEERING

A PEDAGOGICAL ADOPTION MODEL FOR THE CREATION OF VIDEOGAMES IN FORMAL EDUCATION

FERNANDO SIEGFRIED ROJAS HARNISCH

Thesis submitted to the Office of Research and Graduate Studies in partial fulfillment of the requirements for the Degree of Master of Science in Engineering.

Advisor:
JAIME NAVON COHEN

Santiago de Chile, October 2010

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A mis padres Violeta y Cesar, a mis hermanos Isabel y Johann, y a mis familiares por su apoyo y afecto incondicional. A Angela por su ternura y comprensión sin límites.

Con amor para todos ustedes.

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Acerca de la dicotomía Teoría-Práctica y de la pregunta sobre cuál de estos dos aspectos es el más importante en la educación puedo comentar lo siguiente: luego de humildemente haber estudiado la educación desde la teoría y luego de haberme involucrado en la educación desde la práctica puedo decir que lo más importante no es ninguno de estos aspectos, lo más importante es la Inspiración. Es este amor que los docentes profesan de sus estudiantes y la pasión que lo acompaña lo que prevalecerá frente a cualquier modelo educativo y cualquier práctica educativa.

INDICE GENERAL

Pág.

LIST OF TABLES

Pág.

LIST OF FIGURES

Pág.

RESUMEN

Investigaciones realizadas en la actualidad sugieren la existencia de diversas oportunidades educativas que emergen del uso de videojuegos en la educación formal, si bien su uso ha sido principalmente instruccional se hace interesante profundizar un enfoque construccionista que esté alineado con el involucramiento de los jóvenes en las culturas participativas. Para esto se presenta una modelo de incorporación pedagógica para la creación de videojuegos en la educación formal que permita mediar en la enseñanza de distintos sectores curriculares. Dicha propuesta fue aplicada en una escuela pública de alta vulnerabilidad social ubicada en Peñalolén (Chile) la cual involucró el trabajo de 63 alumnos de nivel NM1 (1er año medio) mediante la utilización de la herramienta RPG Maker VX para la creación de sus propios videojuegos. Para capturar una imagen general de lo ocurrido en las sesiones de trabajo se utilizó una metodología de estudio descriptivo para así analizar las interacciones entre los alumnos, el rol de los docentes y las oportunidades educativas que emergen de la experiencia. Los resultados muestran la sensación de éxito que le atribuyen a la experiencia los docentes y estudiantes participantes, los tipos de interacciones presentadas entre los alumnos y la importancia de una correcta capacitación a los docentes.

Palabras Claves: Educación, Creación de videojuegos, Construccionismo, RPG Maker VX

ABSTRACT

Recent researches suggest the existence of several educational opportunities that emerge from the use of games in formal education. Although this use has been primarily instructional, it is interesting to deepen a constructionist approach aligned with the involvement of young people in participatory cultures. A model of pedagogical adoption for the creation of videogames in formal education is presented to mediate curricular learning in different curriculum areas. The experience was implemented in a public school of high social vulnerability in Peñalolén (Chile) involving 63 students at 9th grade who used the RPG Maker VX tool to create their own videogames. A descriptive study methodology was used to capture an overall picture of what happened in the sessions and analyze the interactions between students, observe the role of teachers and capture the emerging educational opportunities. The results revealed a feeling of success among the participating teachers and students, several interesting patterns of interaction among students and the importance of adequate training to the teachers.

Keywords: Education, Videogame creation, Constructionism, RPG Maker VX

1. INTRODUCTION

Recent studies from fields such as sociology, psychology and neurobiology have suggested the existence of two profiles of people in the new 21st century society. These profiles show substantial differences at both the cognitive, social and generational dimensions. On one side we have the "digital natives" who are those who grew up surrounded by a digital culture and use these technologies intensively; we can see them in the fluent use of computers, phones, game consoles, digital music players, video recorders and other technological artifacts by our youth. On the other side, the "digital immigrants" who were born before the digital technological revolution have had to adapt to these new environments. This explains one important different between these two profiles: they tend to unfold differently with technology. To illustrate this situation Prensky (Prensky, 2001) recognizes certain practices in the digital immigrants suggesting a "digital inmigrant accent" that manifests in things like turning to the Internet for information second rather than first, or in reading the manual for a program rather than assuming that the program itself will teach us to use it. Today's older folk were 'socialized' differently from their kids, and are now in the process of learning a new language. And a language learned later in life, scientists tell us, goes into a different part of the brain".

What are the possible implications on education? These differences are reflected in students and teachers and, unfortunately, our school system was designed for people that no longer exist since our students have changed radically. This generational change has been documented in various countries around the world for which the OECD coined the term "New Millennium Learners" (Pedro, 2003) to refer to the new group of trainees has grown accustomed to:

- Accessing information mainly on non-printed, digital sources.
- Giving priority to images, movement, and music over text.
- Feeling at ease with multi-tasking processes.
- Gaining knowledge by processing discontinued, non-linear information.

This scenario presents major challenges for our digital immigrant instructors as they must put their efforts to educate a generation that speaks an entirely new language. It is no longer valid to assume that the same educational system that worked to educate the older generations can fulfill its mission with this new generation. This is why it becomes especially important to seek new strategies and pedagogical models aligned with respect to the digital culture of the 21st century that enable to mediate in teaching the regular curriculum.

In Latin America, however, there have been no serious studies on this technology-generational difference. This in turn has prompted the creation of imaginary about the use that our young people give to technology (Goat-Torres, Martial -Vivas, 2009). While our students have a "more natural" relationship with the technology, is clear that in the context of disadvantaged schools young people have poor technological competences despite some computer training received at school. This technological gap impacts negatively on the participation of children and young people in the so-called participatory cultures. This suggests a decrease on the creation of digital content from these actors resulting in a participatory gap (Jenkins et al, 2006.)

Research oriented towards the insertion of the elements of the new culture into educational practices include the use of digital games which can be considered the principal disseminators of the culture of interactivity (Gros & Garrido, 2008.) In this scenario of important educational opportunities from one side, and technological and participatory gap of the less favored students on the other, we propose a pedagogical adoption model for videogame creation in formal education with the goal of implementing it in a high social vulnerability school of Peñalolen (Chile) and subsequent evaluation in terms of: (i) achievement in creating the game itself, (ii) the teachers tool appropriation process, (iii) interactions of student-teacher and student-student and (iv) emerging educational opportunities.

2. VIDEOGAMES & EDUCATION

Up until recently research on the educational potential of the videogames was focused mainly on informal learning contexts, namely, the use that young people give to videogames out of school activities and what their could learn from them. This early research helped in demonstrating the educational potential of video games, not just those who are called "educational game" but also the "commercial off-the-shelf videogames" widely used by digital natives. James Paul Gee argues that a good commercial video game is designed around a good theory of learning and for that reason it can enhance deep learning (Gee, 2005).

The educational potential of videogames outside the classroom has prompted new emerging research focused now on identifying educational opportunities in formal education and variety of alternatives have been proposed.

2.1. Pedagogical use of commercial off-the-shelf videogames

By using commercial video game, researchers have inquired about the possibility of mediation in the teaching of curriculum content. This approach has advantages especially in terms of costs as compared to game development for educational purposes since there is no need to earmark funding for this, something which is much more expensive than purchasing a few commercial licenses. In addition, using a commercial game is very attractive to students who recognize it as an important part of their lives as digital natives. These games, however, were not designed with an educational objective, much less it was considered their use in a classroom and therefore it is not natural or intuitive to use them in formal education.

Research by Futurelab (Sandford et al, 2006) in schools of England identified a number of interesting situations with respect to commercial off-the-shelf video games and their educational potential. The research considered two activities: (i) National surveys conducted by Ipsos MORI that covered primary and secondary

teachers and school children aged 11-16 and (ii) Detailed 10 case studies corresponding to teacher approaches of use of games for learning.

The 10 case studies were completed in four schools that represented a range of urban, rural, state and private settings. Two schools offered lessons based on a competency-based curriculum derived from the RSA's Opening Minds project, in addition to lessons based on a traditional curriculum. The games used in the schools were: The Sims 2, RollerCoaster Tycoon 3 and Knights of Honor.

A few of the most relevant conclusions from that research follows:

- A generational divide is still evident, with a significant majority of teachers (72%) not playing games for leisure, compared with 82% of students playing games outside lessons at least once a fortnight. Boys were also more likely to play games for leisure than girls. The majority of teachers and students surveyed reported that they thought games would motivate students to engage with learning. This situation seems to indicate that both teachers and students hold educational potential is closely linked to the motivational power that have video games.
- The teachers and students in the case studies generally reported that using games in lessons was motivating. However, the study suggests that student motivation might be more likely to arise 1) when students were using games familiar from their home environment, and 2) when students were able to have some degree of autonomy in playing the game.
- Concerns over curriculum and assessment appeared to be more influential in selecting the age of students to use games in lessons than the age rating for the games. No teacher expressed concern about using 'teen games', ie those suitable for 13 and over, with 11 year-olds.
- While teachers needed a certain level of familiarity with a game to be able to use it in their teaching, achieving particular educational objectives through the use of the game was more dependent upon a teacher's knowledge of the curriculum with which they were working than it was on their ability with the game.
- Using games in a meaningful way within lessons depended far more on the effective use of existing teaching skills than it did on the development of any new,

game-related skills. Far from being sidelined, teachers were required to take a central role in scaffolding and supporting students' learning through games.

- Regarding the commercial games that are possible to use in formal learning contexts the study identifies a number of factors to consider: (i) the technical infrastructure of the school (including personnel and facilities), (ii) organizational and professional aspects (including the organization of time and space in the school, cultures of collaboration/knowledge sharing, traditions of 'best practice' in lesson planning, and classroom rituals), (iii)the extent to which games can be 'disaggregated' and appropriated to meet specific needs, (iv)the individual teachers' personal experience of games play, and their personal and professional identities as teachers, and (v)the pervading cultural expectations of children's attitudes to and expertise in playing computer games. From the above it follows that to design and plan lessons using commercial video game is required to evaluate these different variables to link the experience provided by the game with the aims of the curriculum.

2.2. Educational game development

The fact that commercial games (which have no educational purpose) show a potential to mediate the teaching of certain contents of the curriculum motivated some researchers to take an active role in the development of new video games in pursuit of educational objectives more clear and focused in the curriculum. This has certain advantages over the use of business games because a well-crafted design can lead to a more specialized piece of software that best responds to the demands of teachers and students. Designing, for instance, a game that does not require excessive play time on the part of students so it can be used during classroom time.

On the other hand, a big disadvantage of this approach is the high cost of designing and implementing an educational video game that can lead to (if money is limited) poor implementations and user experience offered to students who are used to last generation high quality games.

In a survey of initiatives in educational games, Jenkins, Klopfer, Squire, and Tan (Jenkins et al, 2003) described the design and testing of three video game prototypes: Supercharged!, a game on electromagnetism; Environmental Detectives, an environmental science game; and Revolution, a game for American history. Each has a narrative structure that students follow to determine their objectives or goals. Players take the role of a charged particle in Supercharged!: a scientist in Environmental Detectives; and a soldier, revolutionary, or townsperson in Revolution. Each game has distinct objectives and a variety of rules frame the play. Players must master the rules of the game to accomplish the objectives. For example, the laws of electromagnetism provide the rules in Supercharged!. In this way, using a curriculum framework is possible to develop games that can present content of the curriculum so attractive to children and youth of this new generation of learners.

2.3. Creation of video games

Usually the main objective pursued by game-building activities in education has to do with the development of skills associated with the use of technology, particularly basic programming skills, but the concept of "learning through design" has began to show new avenues of research open to further discussion.

The concept of learning through design has a long history in education, though until very recently design activities were more of an isolated practice than widely used in schools (Haury, 2002.) Recent educational reform movements have reemphasized the need to pay greater attention to design, particularly in the context of science and technology-related learning (Denning, 2007; ISTE, 2007.) This emphasis is reflected in the broader scientific and business community, where “design thinking” is now a valued capability (Kelley & Littman, 2001.) The call for design-based learning is rooted in the belief that the act of designing is fundamental to the work of all professions and more broadly, to the pursuit of desired social and political ends. As a process, design activities engage students in active construction of new knowledge, as they construct artifacts to achieve

specific ends. This knowledge can pertain to a wide range of traditional academic disciplines. As a goal, design or design thinking involves the ability to define and redefine ill-structured design problems, engage in iterative problem-solving, and integrate skills and knowledge from across disciplines.

Past educational approaches to design-based learning tended to emphasize "school situated design;" that is, design located within the context of traditional academic subject matter and ways of thinking. Many of these new forms of media (like computer games) and culture involve more sophisticated language, tools, and thinking skills, such as simulation and modeling, than what young people encounter in school. In addition, engaging in production with new media can serve as a starting point for helping young people become more critical consumers of today's media culture (Squire, 2005.)

A wide range of software tools for videogame creation is available today. They differ with respect to the specific objectives that need to be addressed which in turn conditions the programming skills needed to use the tool. The Logo programming language developed by Seymour Papert, Wallace Feurzeig, and Daniel Bobrow in 1968 is paradigmatic if the goal is teaching programming concepts and became a centerpiece of this line of research in educational strategies. Papert conceived Logo as an environment where children could learn to "talk" to a computer (Papert, 1980). This conversation was carried out as children entered instructions that the computer would interpret and then enact through "turtles" on the screen.

Over the years, Logo has undergone major changes to provide greater accessibility and functionality to learners of programming languages. One of the most fundamental changes has been the extension of the programmer's ability to issue commands to more than one turtle (the core building blocks of the system) at the same time. Newer versions of Logo such as StarLogo (Resnick, 1994) and NetLogo allow the learner to create contained simulations representing complex phenomena. StarLogo TNG, one of Logo's latest incarnations, has a somewhat different goal than its predecessors. While TNG retains the overall purpose of

serving as a tool to create and understand simulations of complex systems, it has the more specific goal of making programming easier to learn and more appealing by incorporating tools to make games in 3D environments.

The research conducted by Yasmin Kafai centered into mediating the teaching of curriculum trough videogames. He describes an educational intervention in which 16 fourth graders were introduced to Logo and over six months, given the task of producing games to teach fractions to younger students (Kafai, 1995.) Students who created games performed better on average than a control group on measures of fraction knowledge and Logo programming sophistication.

One of the popular trends in commercial videogogames during the last ten years has been that game studios license the software upon which their videogames are built to allow others to create their own modded (modified) versions of the game. This software commonly consists of a game engine (the core software system upon which the game runs) and a set of mod tools (level and graphic editors, software code libraries) that allow modifications to the original game ranging from surface changes in appearance to deeper changes in rules and game play. A good example of this is Adventure Author, a platform based on the Neverwinter Nights Aurora toolkit. Taking advantage of the story-centered nature of the Neverwinter Nights roleplaying game, Adventure Author was designed to promote the acquisition of literacy skills (with an emphasis on storytelling) through game design by children (Good & Robertson, 2005). With Adventure Author, students produce original storylines in a game form, using the Aurora toolset to modify the environments, characters and story of the game. Adventure Author removes the need for learners to learn programming in order to design their games, with the tradeoff that players can only make game genres restricted to the Neverwinter Nights model.

Research literature suggests that supporting the student understanding of game design can be a valuable starting point for learning to think about complex interactions among variables, people, and technology. Nevertheless, to appreciate the educational opportunities available in the creation of video games, it becomes necessary to understand the educational theory that frames the activity. Seymur

Paper´s constructionism is an idea that evokes “learning by doing” but in fact there is a much deeper sense in his work. In the next chapter we review in detail his work and how constructionism can be put to practice with the creation of video games by the students.

3. CONSTRUCTIONISM: LEARNING THEORY FOR VIDEO GAME MAKING

For a deep understanding of constructionism, Papert gives us several indications. We can say that both constructivism and constructionism have the same connotation of learning by “building knowledge structures” irrespective of the circumstances of learning. He also adds that this happens in a particularly appropriate context where the learner is consciously engaged in constructing a public entity (Papert, 1991). In this way the constructionism suggests that the learning process can become more effective when students are actively involved in the creation of tangible objects. Therefore we can infer that unlike constructivism in which knowledge construction is rather “internal” (according to a process of accommodation and assimilation of the learner) the contructionism presents learning as building “external” knowledge strongly linked to the product created.

Constructionism makes possible that certain concepts and ways of thinking considered today beyond reach of the children understanding can enter in what they know "spontaneously" (in the sense in which Piaget speaks of geometry or the logic). Other concepts children do learn in schools but reluctantly could be learned with the enthusiasm seen in Nintendo games. This vision led to definition of constructionism and serves as an ideal case to judge the results that have been achieved. In particular, it illustrates the sense of opposition between constructionism and instructionism, and thus leads to a discussion of the guidelines for innovation and improvement in education.

Papert in his paper “Situating constructionism” indicates that it is possible to make two kinds of scientific claim for constructionism: (i) the weak claim is that it suits some people better than other modes of learning currently being used. (ii) The strong claim is that it is better for everyone than the prevalent “instructionist” modes practiced in schools.

Papert speech reveals a deep disappointment of the pedagogical practices used by teachers at that time. Today the value of different teaching models in relation to different contexts and educational goals they pursue has been widely accepted. Because of this, it

is valid to assume multiple models of teaching and not just one as suggested by Papert in their work.

Constructionism allows a wide range of intellectual styles and preferences for each person to find a balance, so the role of the teachers must change from a traditional approach where they deliver knowledge to students to facilitators of student learning.

The creation of video games clearly presents a constructionist approach for learning due to the large number of components that are necessary to create (graphics resources, sounds, music and scripts) and the need presented by the creators to share their products with the video game communities.

4. VIDEOGAME MAKING IN SCHOOLS

There have been several studies that have explored the educational opportunities of the process of creating videogames in formal education. One focuses on the use of GameStar Mechanic (Games et al, 2008), which is an RPG (Role-Playing Game) style online game where middle and high school age players learn the fundamentals of game design by playing roles as “game mechanics” charged with the making and modding of games. The study shows changes in their abilities on several indicators: (i) acquisition of specialist language associated to design, (ii) ability to design a dynamic system of rules that results in a playable game, (iii) development of specific game design skills and knowledge, (iv) participation in a broader affinity space of emerging game designers, and (v) engagement in an iterative and collaborative process of design.

Similarly observations were made from a three-year ethnographic study that explored youth designing games with Scratch (visual programming software for creating digital stories and videogames) by collecting observations, design drawings, log files and interviews. An archival analysis of Scratch files revealed the range of different game genres produced within the clubhouse culture such as classic arcade, racing action-adventure, fighting, and shooter games with the largest number falling into mixed genre. Peppler and Kaffai argue that learning through game design addresses technical, critical and ethnical aspects of participation and can provide a pathway into participation (Peppler & Kaffai, 2007).

From the body of research on the subject, it is already clear that video games do affect learning. While there is widespread consensus that games motivate the players to spend time on task, thus mastering the set of skills that the game requires, there is a no agreement over the specifics about what provokes that motivation, some attribute the compelling nature of games to their narrative context (Dickey, 2005) while others find motivation is linked to goals and rewards within the game itself or intrinsic to the act of playing (Denis & Jouvelot, 2005). The literature reveals that a number of distinct design elements, such as narrative context, rules, goals, rewards, multisensory cues, and interactivity, seem necessary to stimulate desired learning outcomes. Moreover,

researchers are beginning to theorize about the cognitive processes that occur through video game play. As these inquiries progress, a better understanding of educational game design and the production of improved educational games will ensue. In turn, design and development will likely generate further research on the learning outcomes related to educational game play, including those affected by gender preferences.

On the basis of the studies conducted in the context of the creation of video games in schools we present a proposal of pedagogical adoption for this activity in formal education, the experience was implemented in the school Erasmo Escala Arriagada of Peñalolén (Chile). This is a high social vulnerability school with poor technological infrastructure where the students exhibit a considerable technological gap.

5. A PEDAGOGICAL ADOPTION MODEL FOR THE CREATION OF VIDEOGAMES IN FORMAL EDUCATION

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Abstract

Recent research suggests the existence of educational opportunities that emerge from the use of games in formal education. Although this use has been primarily instructional, it is interesting to deepen a constructionist approach aligned with the involvement of young people in participatory cultures. A model of pedagogical adoption for the creation of videogames in formal education is presented to mediate curricular learning in different curriculum areas. The experience was implemented in a public school of high social vulnerability in Peñalolén (Chile) involving 63 students at 9th grade who used the RPG Maker VX tool to create their own videogames. A descriptive study methodology was used to capture an overall picture of what happened in the sessions and analyze the interactions between students, observe the role of teachers and capture the emerging educational opportunities. The results revealed a feeling of success among the participating teachers and students, several interesting patterns of interaction among students and the importance of adequate training to the teachers.

Keywords

media in education, pedagogical issues, secondary education

5.1. Introduction

It has become evident, for researchers in various scientific fields, that the new generation of learners is radically different from the older ones. Different in how they interact with their environment, different in their thinking, and different in the way they process information (Pedró, 2006; Prensky, 2001.) The so-called “digital natives” are those who have grown up with this new technology, as Prensky says “They have spent their entire lives surrounded by, and using computers, video games, digital music players, video cams, cell phones, and all the other toys and tools of the digital age” (Prensky, 2001.)

On the other hand we have the ‘digital immigrants’, those adults who were born and raised in non-digital environment, which makes it to operate differently from those young "digital natives." This difference translates directly to problems in our education system that unfortunately is prepared to educate a generation that no longer exists. Teachers must struggle every day to educate young people that use a completely new and different language (Prensky, 2001) exposing a gap difficult to bridge in the current educational system.

According To Prensky “if the educators want to wave relevance in this century, it is crucial to find new ways to engage the students” (Prensky, 2004.) One of those ways is to incorporate those elements that belong to this new digital culture and use them to mediate teaching in schools. Is in this framework where video games are presented, because they are considered very influential in the culture of interactivity (Gros & Garrido, 2008,) they emphasize the role of the player because he is required to execute actions in a constantly and to participate actively in their experience. This contrasts sharply with what happens with the TV (the key element for the generation of digital immigrants) where people are passive in terms of the content they are given, and there is no feedback provided by the user (Gros, 2007.)

These digital toys have not only served to amuse children and young people, but they have also triggered a creative and participative revolution: online community building, group of clans of gamers, video game modification using tools provided by development companies (Modding), creating video games using tools that facilitate development, or

even the creation of audiovisual material using a video graphics engine (Machinima.) All these phenomena respond to the new needs of "digital natives" who wants to interact with their environment, so much so that it has shaped a whole new culture that uses and promotes a culture of participation (Jenkins et al, 2006). Here children and young people become content creators, sculptors of his own perception of the world, and citizens of the digital age because of the high involvement that represents belong to those cultures.

Because of this shift in focus from individual development towards community, new skills are required in the XXI century. Most involve social skills developed through collaboration and networking, but they are built on traditional skills that are sought in the education system such as critical thinking, technical skills, research skills and more (Jenkins et al, 2006). It is especially important that all stakeholders in the education system promote these skills in our children and young people to make them active participants of the XXI century society.

In Latin America, however, there have been no serious studies on this generational difference. This, in turn, has prompted the creation of an imaginary about the use that our young people give to technology (Goat-Torres & Martial -Vivas, 2009). While our students have a more natural relationship with the technology, it is clear that in the context of disadvantaged schools young people have poor technological competences despite some computer training received at school. This technological gap impacts negatively on the participation of children and young people in the so-called participatory cultures. This suggests a decrease on the creation of digital content from these actors resulting in a participatory gap (Jenkins et al, 2006.)

While the use of video games in education has been implemented mostly from an instructional standpoint, among constructionists it becomes interesting to explore the educational opportunities available in the process of creating video games (Kaffai, 2006.) We propose a pedagogical adoption model for videogame creation in formal education that takes this need into account and also the technological and participatory gap. It was implemented in a public school of social vulnerability located in Peñalolén (Chile) involving 9th grade students (first year of secondary school in Chile) that worked

in groups to create their own video games using RPG Maker VX tool. A descriptive study was conducted to evaluate the implementation of this model in terms of: (i) achievement in creating the game itself, (ii) the teachers tool appropriation process, (iii) interactions of student-teacher and student-student and (iv) emerging educational opportunities.

5.2. Videogame creation in formal education

Videogame creation can provide a rich context for learning fundamentals of programming, teamwork and even to mediate in the teaching of academic content (Peppler & Kaffai, 2007.) It becomes interesting then, to incorporate the process of creating video games in education not only to mediate in formal education curriculum, but also to bring the schools into this new culture of participation and thus to mediate also in the process of helping the students to become full members of this culture. To achieve adequacy of the process of creating video games in the school context, it is important to identify those features that have educational opportunities and equip them so that they can be used in the school context. Among the features of the process that present educational opportunities we have the following:

i. *Programming.* Videogame involves knowledge of programming as a fundamental pillar, and this is why it is presented as a key aspect that could be mediated by Math teachers in content related to basic arithmetic, logic and probability, and Technology teachers who can link this knowledge into curricular learning.

ii. *Game design document.* Every game is conceived in a design document where all the details involved in its creation are explained. Producing such a document presents educational opportunities in written communication and processing of narrative texts (language sector)

iii. *Teamwork and assignment of roles.* The development of a game involves the coordinated collaboration of people who provide the broad range of needed expertise (programming, art, fiction, management). This encourages collaboration between students by defining roles in work teams. Furthermore, teachers of the various sectors could coordinate their classes to contribute to the development of video games which

involves the same common goal type collaboration among teachers: the development of video games for students.

iv. *Incremental development.* Modern software development techniques try to mitigate risk by providing regular versions of the software. This approach can be beneficial for teachers as they would have continuous feedback about students progress (those who could be assessed). It also introduces students to a new way to face a project very different to the more traditional execution.

v. *Use of technological tools.* Development requires the use of various tools for the creation of the components of the video game. These components include artwork, music resources, social networks, blogs, etc. Each of these components is integrated into the development by the video game creation tool and it also creates space for the integration of various curriculum areas.

Our pedagogical adoption model for the creation of educational video games is strongly motivated by these huge educational opportunities that can be articulated within the current school context.

5.3. Proposal of pedagogical adoption

Our pedagogical adoption model considers two main aspects: curriculum and methodology. We discuss now both aspects in detail.

5.3.1. Curricular adoption

The adoption of the creative process of video games in the school setting should occur under the existing framework of the curriculum. Therefore we propose to link the experience primarily to the technology sector, where the main focus is already teaching technological tools (e.g. word processors, presentation software, etc) and the teachers could mediate in the teaching of the new video game creation tool.

The technology sector will have total ownership of the experience, so the creation of all necessary components for building the video games is carried out in this sector. However, other curriculum areas can be involved in further development of

these components. Thus the field of language teaching could mediate the content associated with written communication through the creation of the Game Design Document and likewise other curricular sectors could also be involved: History by the creation of video games located in a historical context, Math by mediating the teaching of basic arithmetic logic and probability, Art in the creation of digital art resources, Music education in teaching musical composition, etc. More areas are included depending on the provision of teachers and their flexibility to manage the entire process.

5.3.2. Methodological adoption

The nature of the game creation process and its relationship to formal education suggests the use of a model based on project-based learning. This way, students aim to develop their own games through a semester project at school. The project-based learning is used in many schools because it provides a learner-centered approach, a fundamental pillar in the constructionist model.

5.3.3. Proposed model

In addition to the activities of different curriculum sectors, we propose that teachers mediate in involving the students into a participative culture through two types of activities: (i) Online participation, where students share their video games on the Web through the use of blogs, social networks and communities, (ii) Offline participation, or any activities that involves sharing sessions and discussion of the games created by students as well as associated components (e.g. Game Design Document.) The offline participation provides some support in case that there is inadequate or nonexistent internet connection on the premises and may include classroom activities, exhibitions at school, participation in technology fairs, etc.

Considering both curricular and methodological aspects our adoption model is presented in the figure 5-1.

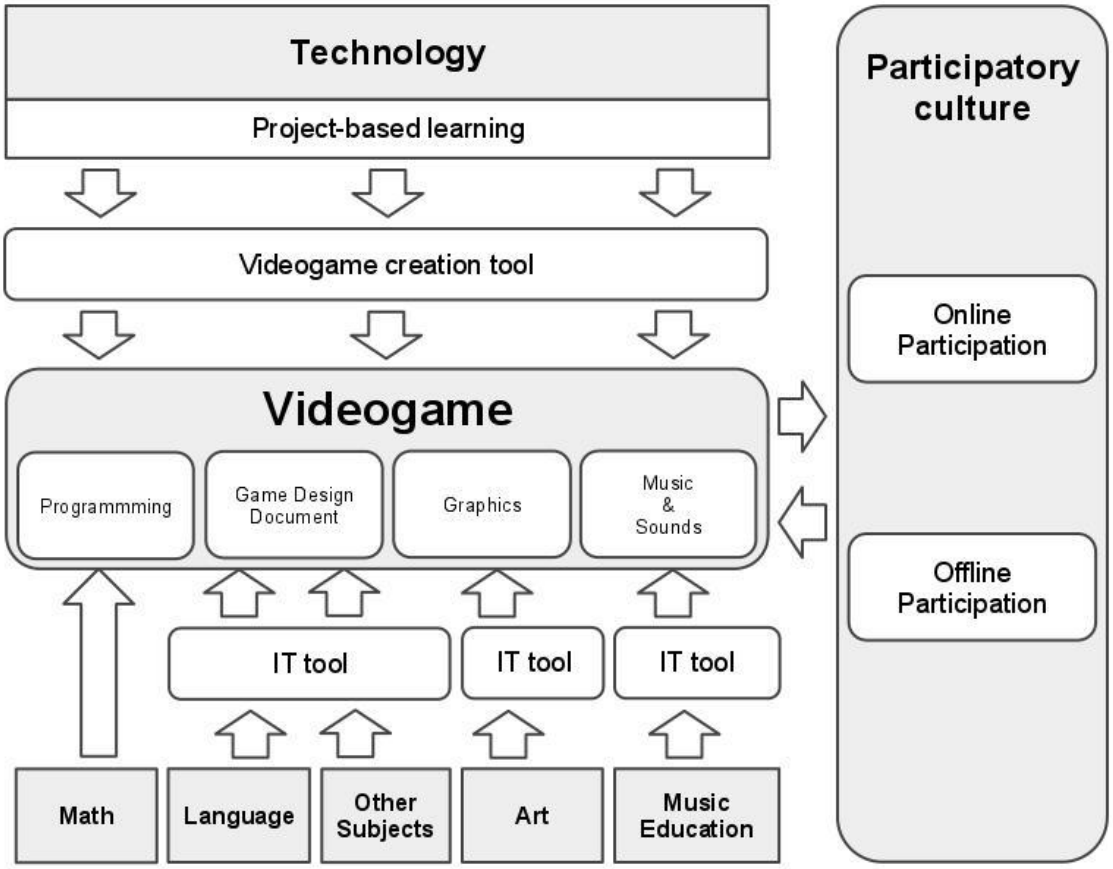


Figure 5-1: Pedagogical adoption model for videogame creation in formal education

Unfortunately the current school system present several restrictions such as different time schedules between teachers, limited time for lesson planning, different classroom time per curriculum sector involved and different teacher availability and enthusiasm. Therefore, the model must be adjusted and customized for each educational.

5.4. The experience

In June 2009 we had a meeting with two technology teachers of a high social risk school of the Peñalolén county in Santiago. They had a serious problem of difficult student coexistence in the school and they thought that could be addressed through a project that would involve the creation of role-playing games. The students would work in their projects during the pedagogical hours that were assigned to technology.

We saw a good opportunity to validate our model by implementing an experience with these kids since the high social vulnerability of the school suggested the existence of an important technological and participatory gap.

For the experience we decided to involve 63 students at 9th grade that were divided into three courses (K-9 A, K-9 B, and K-9 C.)

5.4.1. Video games creation tool

We decided to use RPG Maker VX tool for creating the role-playing games because it allowed the incorporation of multimedia resources in student-created videogames, and because this tool had already a lot of multimedia resources, a key advantage in a scenario of school connectivity problems. In addition to that, the RPG Maker VX tool had features that caught the attention and interest of the teachers in terms of motivation that could awaken in students, aspect that was considered crucial for the success of the experience. We decided to limit the available features of the tool though, to just mapping, management of the game database and event programming (ignoring programming via the Ruby language.)

5.4.2. Planning

The technology course at the school considers a semester project, for this reason we planned classes that involved 13 weeks. These classes included both the instruction to students in the use of the RPG Maker VX tool as well as the work of students in their games. Each course had two pedagogical hours in the computer lab and one pedagogical hour in the classroom. The course was offered simultaneously by two teachers.

The first five weeks were dedicated to train the students in the use of RPG Maker VX in the computer lab. The class hour was used to reinforce and to answer questions. During this time, the different working groups as well as the different game stories were also created. For the definition of the stories we invited the language teacher so the students worked in the Game Design Document in the

hours that were destined to regular curriculum content related to oral and written expression. This activity took place during the second and third week.

During weeks 6 to 13 the computer lab layout was changed so that each group could use two computers. The actual creation of the videogames took place during this period using the lab hours. The classroom hours were used to show additional capabilities of the tool, to review similar commercial games and to monitor the progress of each group.

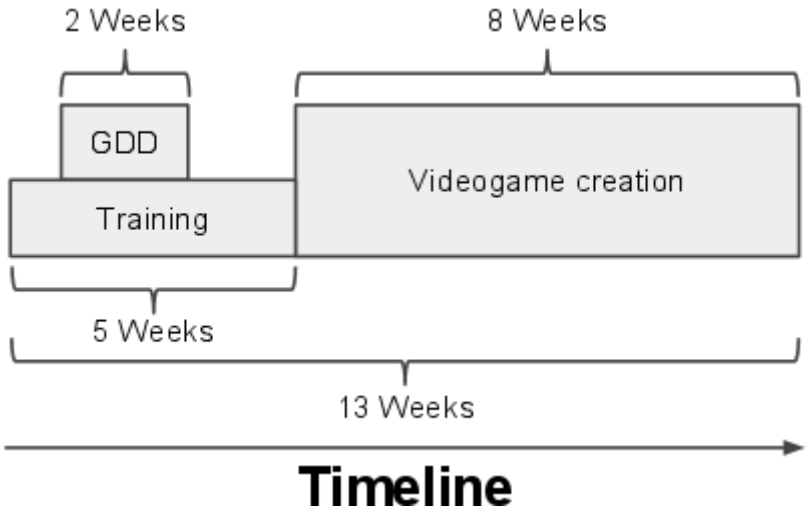


Figure 5-2: Timeline referred to activities in the experience.

5.4.3. Pedagogical model

For the implementation of the classes two settings were considered: (i) instructional and motivational classes where classroom teachers used a laptop and projector for teaching RPG Maker VX, and (ii) student work in a computer lab with 20 laptops on which the games were developed. The pedagogical model presented here is the result of improvement over a previous model that only considered using the computer lab classes.

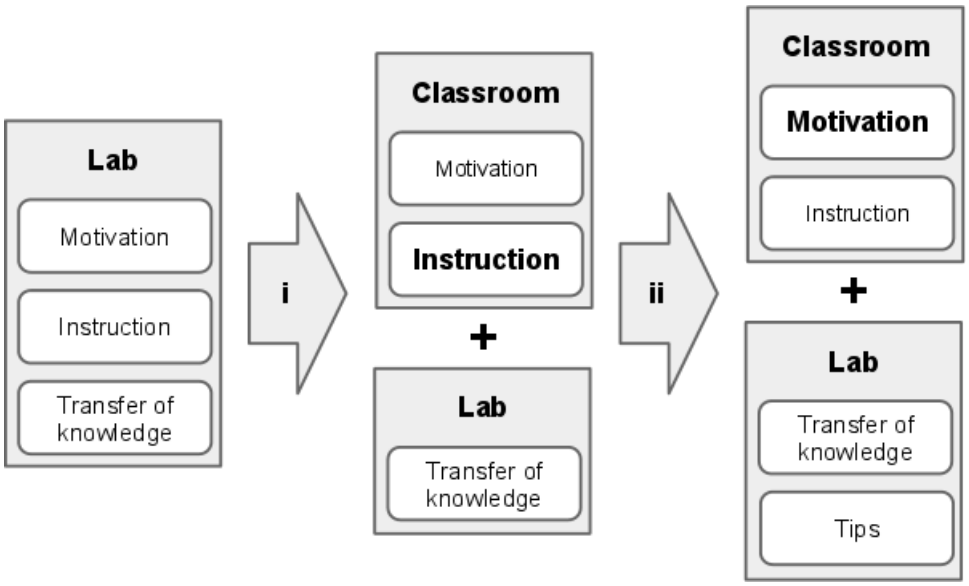


Figure 5-3: Changes in the pedagogical model in response to reflection cycles.

The change in the pedagogical model was made thanks to the use of a "reflection time" carried out immediately after classes. Here is how the transition took place:

i. Starting with the third week of the study, the pedagogical model that originally considered the exclusive use of the computer lab, was changed to a mixed model where instruction and motivation takes place in the classroom using whiteboards (one teaching hour) and knowledge transfer takes place in the computer lab (two teaching hours) where the different groups make progress towards the goal. This change was proposed by the teachers who reported that there seemed to be a "barrier" between laptops and instruction in class.

ii. From the fourth week it was necessary to include small windows of time during work in the computer lab where students were showed additional features that could include in their games (in the form of tips). This responds findings in the audiovisual record of the classes that showed that students could sustain a continuous work with the tool for about an hour before getting distracted and losing focus in their work. So we decided to stop for new tips every 20 to 30 minutes. We also learnt that the classroom time should be more motivational than

instructional, because the students showed a greater acceptance of rapid and dynamic classes than slower classes more oriented to assure content learning.

5.4.4. Continuous training of teachers

The teachers attended a two hours a week course on the use of RPG Maker VX tool. They were also given laptops and personal software licenses so they can practice after school hours. This was done in parallel to the experience with the students so what the teachers were learning one week was used as a guide of planning next week with the students.

5.4.5. Reflection cycle

In order to respond early to special or unexpected situations and also to keep the dynamics of the pedagogical model, a 15 minute reflection time session was carried after each class either in the lab or the classroom.

5.4.6. Participation and collaboration among students

To provide visibility of projects among students two ways of participation were proposed: (i) to plan classes in which students present their projects to classmates and (ii) to let each group publish a blog with the latest news, progress, points achieved and not achieved, etc. Unfortunately this last option was not possible to implement due to connectivity problems in the school. In addition, and as a way to allow informal intergroup collaboration, the students were encouraged to take a look at the game that their peers were developing in the laboratory.

5.4.7. Implementation experience

The experience was implemented and carried out between August and November, where the different activities in the overall planning were done. Three classes of the same level (K-9) were taken for the experience. Each class had 30 students, but due to the high dropout rate and the difficulty of maintaining the process with

these students we chose to record the progress with those who completed the process and attended the meetings.

Finally, the total number of students involved in the experience was 63, of which 17 belonged to the K-9 A, 27 to the K-9 B and 19 to K-9 C. Each of the courses had one two-hour laboratory session per week where they used a computer individually or in pairs depending on the availability. In each of these courses groups of two to five students were formed. The table 5-1 shows the student population distribution for the experience.

Table 5-1: Distribution of participating students.

Groups	**Female**	**Male**	**Total**
K-9 A	7	10	17
K-9 B	15	12	27
K-9 C	11	8	19
Totals	33	30	63

5.5. Analysis of the experience

We performed a descriptive study in order to get a general picture of what happened in classrooms and computer labs during the implementation of the proposed pedagogical adoption of videogame creation in formal education presented here. To this end, information from various sources was captured and recorded including research notes, audiovisual record of the classes in the classroom and computer labs, video game review schedule, interview with students and groups and surveys of to student attitudes.

i. *Research notes*. We took research notes associated with every class (classes in classroom and computer lab) to identify interesting things that emerged from the experience. These documents considered the submissions made by both research associate and also by the teachers. These notes also included the comments made by the teachers during after class reflection cycles.

ii. *Audiovisual recording.* During the initial 5 weeks an audiovisual recording of every class either in the lab or the classroom was performed so we could have a precise review of a particular situation.

iii. *Video Game Review Guideline.* In collaboration with the teachers we designed a guide that could be used to evaluate qualitatively and quantitatively the game developed by the different groups. The development of the guide considered both the narrative aspects (back-story and game flow) and the features RPG Maker VX used (maps, events, music, sound effects, main character, secondary characters, non-playing characters, inn, tavern, shop and battles). The narrative aspects were qualitatively evaluated in three levels:

Table 5-2: Scale of assessment used to evaluate the narrative aspects.

Label	Description
Complete	The game has a coherent back-story which is coherent with the game activities, the game flow is also coherent and there is an ending to the story.
Consistent	The game has no back-story, the game flow is coherent but there is no ending to the story.
Insufficient	The game has no back-story, there is a game flow but not necessarily coherent and there is no ending to the story.

From these narrative aspects and quantitative assessment of the elements of the student-created video games the following performance levels were established:

Table 5-3: Assessment of the student-created video games.

Label	Achieved aspects
Outstanding	• Complete narrative aspects • 1 World map • 1 to 3 Town maps • 1 Shop *(optional)*

	• 1 Tavern *(optional)* • Music per map • 1 Sound effect per map • Main character • Secondary characters • 1 to 3 Non playing characters per map • 2 Events or more per map
Sufficient	• Consistent narrative aspects • 1 World map • 1 Town map • Main character • Secondary characters • 1 to 3 Non playing characters per map • 2 Events per map
Minimun	• Insuficient narrative aspects • World map • Main character • 1 to 3 Non-playing characters • 2 Events

Once the experience ended, every game created by the students was evaluated using the assessment guide shown above. This assessment guide was elaborated with the teachers well before the students created the games.

i. *Interviews to groups of students.* Interviews with the best work groups were conducted to discuss and communicate mainly three aspects: learning as a result of the experience, degree of satisfaction and to show a "walkthrough" of the video game they created. The interviews were recorded both in audio and video.

ii. *Student attitude surveys.* A student attitude survey was designed for the participating students. It considered three dimensions: attitudes toward teamwork, attitudes toward the use of videogames in formal education and attitudes toward piracy. The aim of this survey was to assess possible cross content that may be impacting the students a result of their participation in the experience. From the data obtained from various sources of information the following categories of analysis emerge: student interactions, role of the

teachers, educational opportunities and sense of accomplishment cross that teachers attribute to the experience.

5.5.1. Iteraction between pupils

We analyzed the exchange of ideas, conversations between students, collaborations during game construction and activities involved in the work of students. The objective was to learn how these relationships are built with respect to the proposed pedagogical model. Among the many interactions that occurred in the classroom and computer lab can be described the following situations of interest:

i. *Students seek to share with others their creations at the time they have achieved a goal.* Audiovisual recordings and the comments of the teachers say that students seek to show both their peers and teachers any progress that is perceived as an achievement. These achievements were mainly triggered by two situations: discovering a new feature of the tool that had not been taught in classes or make an interesting use of the functions of the tool that were known to the students. This observation demonstrates that students are concerned about what other people think about what they have created which suggests a degree of social connection with them. The setting of this experience helped the emergence of a situation that could serve as a starting point to establish that we are in the presence of a participatory culture (Jenkins et al, 2006).

The students said that to create good compelling games it was necessary to develop certain skills, suggesting that it is possible to make students aware of the learning involved in the design process of these games:

"We have developed imagination because the imagination helps to create a game that could like to someone"

Student at K-9 B course.

"Creating a game involves using the imagination and knows what children like"

Student at K-9 B course.

ii. *Students collaborate most effectively in pairs*. In the cases where there were more than two people in a group they tended to dissociate into two smaller groups. The fact that two computers are available for each group further contributes to the division into separate subgroups. Sometimes, the students argue the need to work alone, which contradicts the principle of teamwork.

At the end, everything took a natural course characterized by the work of students in all available computers in pairs.

iii. *Active participation of the groups in solving a problem but not in the execution.* There is a high level of involvement and focus on students who are actively working, but on the other hand passivity is observed among those who just accompany the work. It was noted however that such passivity ended when a new implementation problem that needed to be solved appeared. In this case there was a rich exchange of ideas and active participation of all members of the group to reach a decision. Still, even during this trial and error problem-solving phase, it was the same person who was active before the one that worked with the tool:

"I did my game with my friends, but the truth is, I only worked on the game"

Student at K-9 B course

It was infrequent for students to permit the participation of partners in the implementation, except for some rare cases where there was some degree of frustration explicitly expressed by the “bored” students.

5.5.2. The teacher role

During the experience several recommended practices emerge as a result of what happened in the classroom and the computer lab.

i. *Teaching outside the computer lab.* The experience in the computer laboratory shows that it is difficult for teachers to get the attention of students, not only because some students use the computers for other purposes but also because those working actively in the tool do not listen to the teacher. This situation became

evident because some students argued that the lack of attention was the product they were working on their projects.

ii. *Empowerment of the teacher*. It was not uncommon among students speeches like "we already knew" or "the explanation is very slow" pointing a finger at a slow delivery of contents by the teacher in class. This made those students to not pay attention in class. Since students can progress at their own pace in the computer labs important differences in learning and tool appropriation are quite common.

It is necessary for the teachers to have a good working knowledge of the tool, sufficient even for the most advanced students. To verify the hypothesis, the last two instructional classes were given in a different mode where content was presented without pause in a more rapid way. This resulted in pupils showing more attention than in previous classes and even participating in it. Still, the students said they learned only part of the content or none of the contents presented.

iii. *Language barrier for discovery*. Because the RPG Maker VX tool was available only in the English language it was hard for students to discover new features that have not been taught by teachers in classroom. Since RPG Maker VX tool lacks a visual appealing interface for programming events it was necessary for teachers to encourage students in the discovery of new features.

5.5.3. Cross cut educational opportunities

From the student attitude survey that was applied to all the participants, important information on three dimensions was obtained.

5.5.3.1. Attitude towards team work

Student perception was positive about the value of team work before (diagnostic) and after (final evaluation) the experience. There is, however, a slight increase in this positive perception from 56% to 66%.

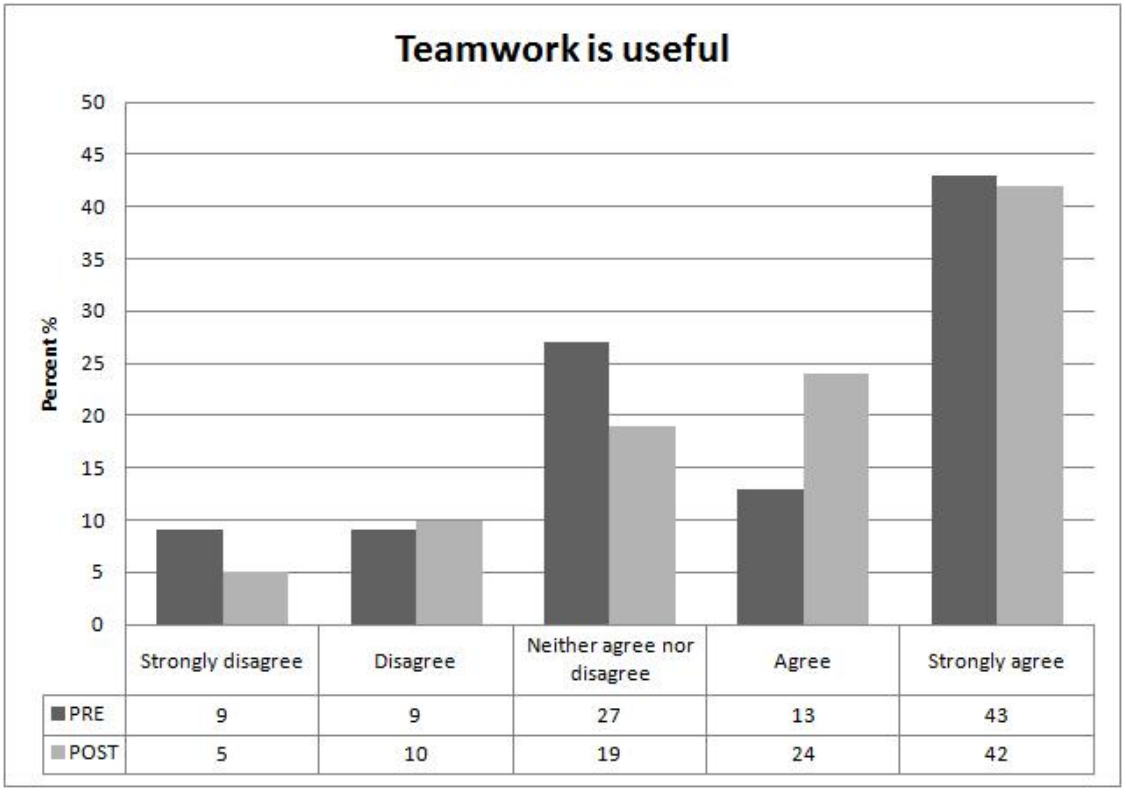


Figure 5-4: Changes in the attitude referred to teamwork.

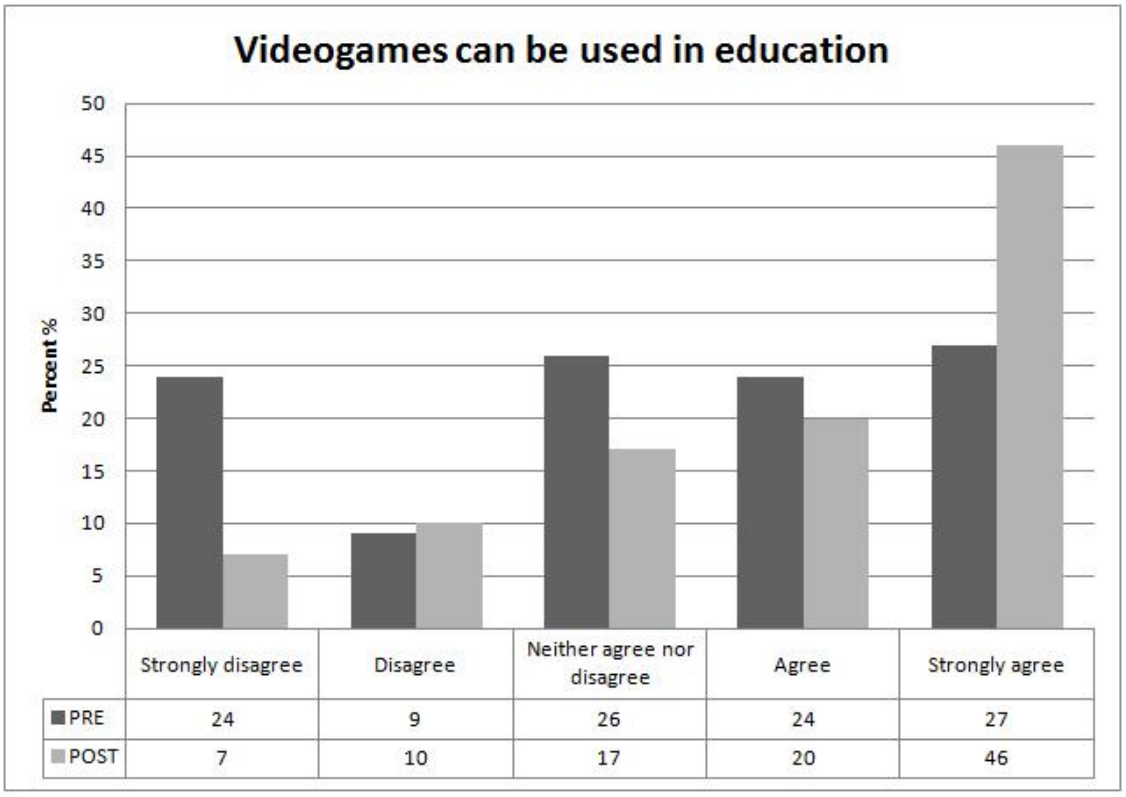
In fact, several students were convinced that they worked better with the tool when they did it alone and not in group. For this reason we cannot be sure about the goodness of the experience and the tool for promoting team work. Further research needs to be done. On the other hand, some students reported that being involved in this experience and having seen the game of his companions allowed them to join as a course. This suggests a possible improvement on the coexistence within the course:

"We have changed as a course, we are more united…before there are certain groups in the course but the games were breaking these groups"

Student at K-9 C course.

5.5.3.2. Attitude towards the use of videogames in Education

The results show that students changed their attitudes regarding the use of video games in education in a positive direction. The statement that "video games can be used in education" got a 66% (vs. previous 51%) of "agrees" and only a 17% (vs. previous 33%) of "disagrees". This finding could support the adoption of video games teaching in formal education not only from a constructivist perspective but also by its instructional potential because these positive attitudes certainly would impact positively the learning outcomes.



	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
PRE	24	9	26	24	27
POST	7	10	17	20	46

Figure 5-5: Changes in attitude referred to the use of videogames in education.

5.5.3.3. Attitude towards piracy

We thought from the beginning that students could change their attitudes towards piracy after they actively participate in a development project that allowed them to

perceive the technical and process management difficulties associated with a software development:

"Is difficult to make video games because involves a great job"
Student at K-9 B course.

The hypothesis was evaluated on the basis of two statements, one in relation to illegal downloads and other regarding the price of commercial videogames. The results in relation to the assertion "It is right to copy (or download) video games INSTEAD of buying them" demonstrate that contrary to expectations. Almost 50% of students agreed with this statement from 27% before the experience. The students who disagreed were only 23% from 38% before the experience. This result challenges the inherent potential of the student participation in a project to create video games to mediate aspects related to teaching aspects related to the illegal downloading of software.

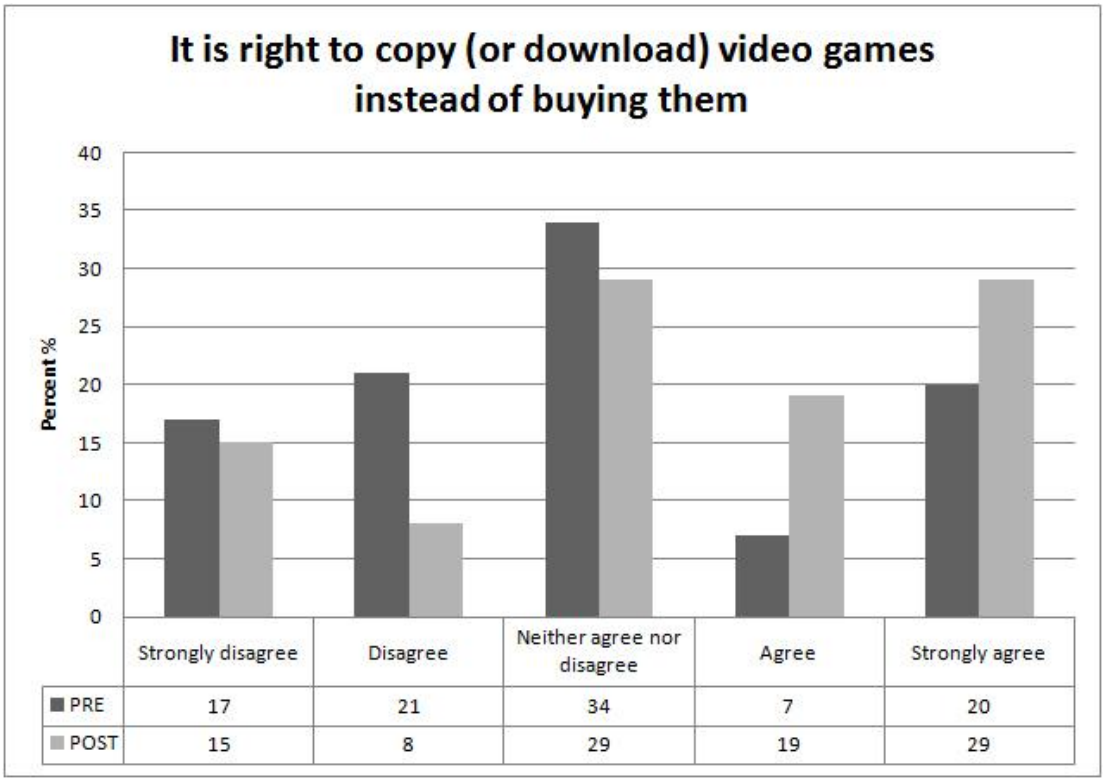


Figure 5-6: Changes in attitudes towards illegal downloading of video games.

The results from the statement "the commercial videogames have a fair price" showed a change in the student perception. Before the development experience only 26% of the students considered that commercial games had a fair price. This number rises to 36% after the experience.

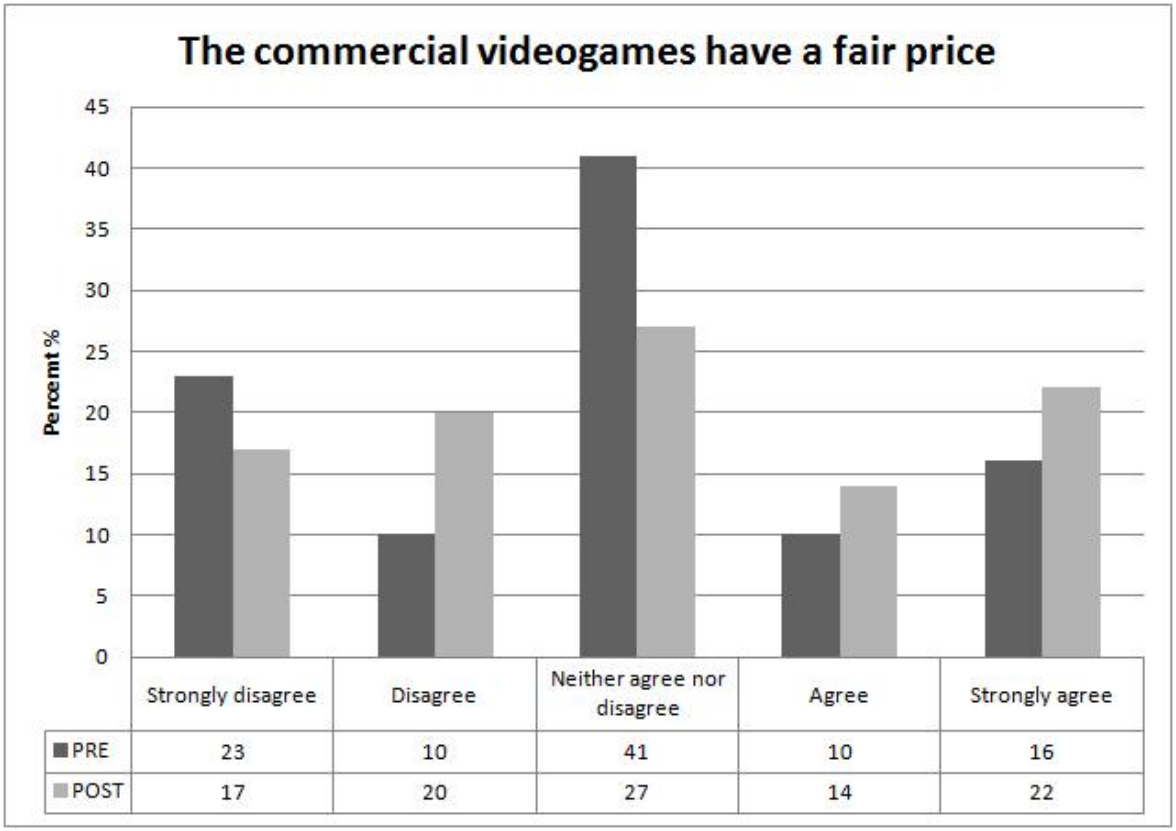


Figure 5-7: Changes in attitude towards the students feel about the fair price in the commercial videogames.

Even more interesting yet is what happens to students that declared that they do not have an opinion. This group was reduced from 41% to 27% suggesting that the experience helped the students to form an opinion about the value of the commercial software. Nevertheless we believe that it is necessary the mediation of the instructor to teach ethics related to property and piracy.

5.5.4. Success Criteria

Success was defined in terms on the number of projects that ended successfully. Taking into consideration the context of high vulnerability of the school, we used as a reference a previous experiment in which students developed videos using Movie Maker. In that occasion less than 30% of the working groups were able to develop a video and only a few achieved the objectives (out of 80 students in which each working group considered two to three people). So we decided that if at least 50% of students get involved and finish their projects it would be sufficient to declare a successful experience.

We evaluated the videogames created by every group using the standard guide. A total of 20 videogames were developed: 6 by the A group, 7 by the B group and 7 by the C group. Of these 20 games 9 got an “outstanding” evaluation, 6 got a “sufficient” and 5 a “minimum”. The following tables show the results:

Table 5-4: Assessment of the student-developed videogames.

Game title	Members	Course	Label
"Salvando a la princesa"	2	K-9 A	Sufficient
"Mortal Street"	2	K-9 A	**Outstanding**
"Vladimir el futbolista"	2	K-9 A	*Minimun*
"Accción en todo momento"	4	K-9 A	*Minimun*
"El virus nuclear"	4	K-9 A	Sufficient
"Final Fantasy"	3	K-9 A	**Outstanding**
"Luigi y sus aventuras"	5	K-9 B	**Outstanding**
"Aron el guerrero"	4	K-9 B	Sufficient
N.N	3	K-9 B	**Outstanding**
"King of the Dragons"	5	K-9 B	**Outstanding**
"El imperio perdido"	4	K-9 B	Sufficient
"Blak"	3	K-9 B	*Minimun*
"El rescate de la princesa"	3	K-9 B	**Outstanding**
"Amor inmortal"	3	K-9 C	*Minimun*

"El guerrero y su espada"	2	K-9 C	Sufficient
"King Warrior"	3	K-9 C	**Outstanding**
"La aventura intergaláctica"	2	K-9 C	*Minimun*
"La guerra entre dos mundos"	5	K-9 C	Sufficient
"V de Venganza"	2	K-9 C	**Outstanding**
N.N	2	K-9 C	**Outstanding**

Table 5-5: Number of students in the different categories of assessment of their games.

Group	Outstanding	Sufficient	Minimun
K-9 A	2	2	2
K-9 B	4	2	1
K-9 C	3	2	2
Total	9	6	5

According to the figures in the table and the success criteria we had previously defined we can say that the experience was a huge success. In effect, 75% of the students developed their games up to a "sufficient" status and almost 50% not only did that but they were evaluated as outstanding projects.

5.6. Conclusions

The implementation of the pedagogical adoption proposal for creation of videogames in a public school game brought a number of interesting issues that corroborated the need for further research and practical experiences involving the educational use of video games from a constructionist perspective. Although the experience carried out in Peñalolen is by no means conclusive and further interpretations require a deeper study, it is possible to draw a few conclusions from what we learnt.

Creation of video games in formal education is very attractive to students and positively impacts their relation and involvement into academic activities:

"There was more motivation in our course because we create something on our own; it's more fun than be in the typical class doing the same thing or all day"

Student at K-9 A course.

"Compared with other subjects in this experience I am learning, playing and creating"
Student at K-9 B course.

This situation is corroborated by the number of successful projects compared with previous experiences (75% of groups at sufficient level) and by the number of participating students that express their agreement with the experience. Moreover, some of them expressed that thanks to these activities, during the 13 weeks of the experience, they stayed longer in school:

"It was fun create games, and therefore, we escaped fewer from school"
Student at K-9 A course.

This is of particular interest given the context of social vulnerability and the high school dropout rate since it would be possible to keep them at school or even attract new students to the school. It becomes then extremely interesting to see the impact of similar projects in other schools with high social.

The proposed model of pedagogical adoption for creating videogames in formal education is a realistic model in face of the activities carried on in educational institutions. Teachers, especially those coming from the technology sector can act as effective mediators in this as on other project-based learning experience, something well known and accepted by schools. Teachers from other curriculum areas can be integrated as well through the development of the required contents and components, however, further investigation is needed on the integration of teachers from other sectors and thereby to validate the model from the standpoint of curriculum.

Due to the unsatisfactory connectivity conditions on the school it was not possible to assess the integration with the participatory culture online, but it was possible to corroborate the relevance of the model relative to the participation offline and to determine that is a key point to motivate the students to share their projects. Teachers corroborated this fact by stating "students feel important and get more involved in all activities."

The RPG Maker VX tool showed some deficiencies regarding ways to share the student-created videogames. It is possible to pack the products for digital distribution but the tool does not offer a built-in digital distribution channel for this purpose. It is recommended that a new version of RPG Maker VX had a system for sharing the student-created videogames in a similar manner to software "Scratch", so it could significantly reduce the student's expression barriers.

The setting used in the experience allows the emergence of various forms of interaction among students. The most common of them appeared at the time the working group found some technical difficulty in the development of the game which triggered: (i) a group discussion on how to solve this problem, (ii) a trial and error process until the problem was solved. Then there were two different scenarios: either the same student continued working on the project or the student who solved the problem took control.

Another relevant form of interaction detected was when students perceived an achievement, situation that incited them to share it with their peers and teachers. If teachers want more collaboration among members of the work groups it is necessary to consider these situations to design classes that maximize the appearance of these interactions. It is also important to consider that the natural disposition that students took in computer lab many times triggered the dissociation of the group into pairs.

Technology teachers need to learn and master the videogame tool because in this way they are empowered to guide and motivate the students as well as to orchestrate the group work in the lab. For the teachers to use this type of tools in their pedagogical practices it is necessary that schools allocate time for training and planning. The experience demonstrated that 90 minutes a week (in five weeks) is not enough for both tasks. We recommend a training program for participating teachers to be done before the classroom implementation to ensure the appropriation of the tool by those teachers.

In relation to cross cut educational opportunities and changes in student attitude, the creation of videogames has a good potential in terms of team work and valuation of videogames for educational purposes which opens new mediation opportunities of using them in formal education.

There was no improvement in the student opinion about software piracy. Even when they could have understood the costs involving the development of a commercial game this that not connects automatically with illegal downloading. We believe that here there are good opportunities for the teachers acting as mediators in explaining the students the implications of piracy.

To conclude, here are a few final recommendations derived directly from what we learned in this experience.

i. *Develop the games from day one.* The five weeks of instruction of the RPG Maker VX tool made the students work on isolated activities to meet requirements of the classes. Some students developed games different to what was defined in their groups, so after completion of the training they had to discard those projects and start again from scratch. According to the teachers students showed resistance to discard their games and abandon the work that had already done. It was the general opinion that a much better strategy would have been to begin the development of video games at the start of the training sessions. It would also provide a better setting to foster incremental and iterative development.

ii. *Encourage discovery learning to foster student interaction.* Since students like to share their achievements, we believe that a methodology centered in discovery learning could maximize the appearance of those situations and therefore it would give an impulse to all the interactions either student-student or student-teacher.

iii. *Carry on training to all the teachers involved.* In this experience only the technology sector teachers were trained in the use of the tool because were they who had the main responsibility. Nevertheless, it became clear that we should have provided some knowledge about the tool to the other teachers who were involved. For example, the language teacher told that her students wrote their game stories without really knowing if the students could be implemented later, something that she could not know either. Also, students asked questions about the tool to teachers who have no idea of what the kids were talking about.

6. CONCLUSIONS: BEYOND THE EXPERIENCE

The experience carried out at the Erasmo Escala Arriagada school highlights a number of issues of particular importance for this line of research. A number of topics related to our research look interesting for a deeper study. We examine here a few of them on terms of their potential in formal education.

6.1. Reducing the participatory gap

Since we live in a society of intensive information technology where our students are already actively involved, one may ask why it is necessary to teach the use of information technology in the context of formal education given that the students are already acquiring these skills and competencies. Unfortunately this scenario is far from reality because there is a "participatory gap" between students who have the technological resources and those that have not any of them. In the case of school Erasmo Escala Arriagada the vulnerability rating 1 of 97% allows us to assume a minimum access to digital technology and a considerable technological gap. It is then interesting to examine the possible effects of involving vulnerable school children into the "participatory cultures" and to evaluate the impact of such participation.

To conduct research on this topic it is important to define the theoretical framework related to a "participatory culture". Henry Jenkins identifies the features that shape participatory cultures (Jenkins et al, 2006):

- a relatively low barriers to artistic expression and civic engagement.
- a strong support for creation and sharing.
- some type of informal mentorship whereby the most experienced pass knowledge to the novices.
- members believe that their contributions matter.

[1] The vulnerability rating (IVE) is an annual measure undertaken by the government of Chile through the implementation of a survey for the first grade of primary and secondary schools who apply.

- members feel some degree of social connection with one another (at the least they care what other people think about what they have created).

It follows from those characteristics that a research that includes the theoretical framework of "participatory culture" requires at least three things: a tool to create a product, a broadcast medium and a need for people to disseminate their work. Thus any study to analyze a possible reduction of the "participatory gap" resulting from the use of video game creation tools should also consider how to publicize the creations of students and to propose a model for encouraging the participation of students in this culture.

In the case of the experience of the Erasmo Escala Arriagada school it should be needed to articulate the video game creation tool RPG Maker VX with a digital communication tools such as blogs, and to use tools like forums and social networks for this purpose. The tool used in (RPG Maker VX) lacks the ability to share projects. In other video game creation tools, however, such as "Scratch" the same tool lets you share projects created with the online community so the cost of sharing the created products in this case are much lower.

Another important point to consider is that in vulnerable schools there are problems that hinder the normal conduct of classes. For example, it is unreasonable to assume that internet access will be available for all activities so the design should include an alternative way for students to share their creations to be able to fulfill the need of a "participatory culture" (in a smaller scale).

6.2. Analysis of the 21st century skills

The activities implemented at school Erasmo Escala Arriagada using RPG Maker VX allows us to identify and quantify the students progress in terms of 21st century skills and competencies. The learning environment encouraged students to do their work under a framework that strengthen these skills.

Our observations and results allow us to assess the skills that seem to be developed by the participating students.

6.2.1. Communication and collaboration

Working in groups with definition of roles, for example, forces the students to communicate and collaborate with their peers. The students had to solve problems presented by the tool by working in groups, a very good scenario for the development of problem-solving and collaboration skills.

We observed some level of attitudinal change on aspects such as team work which confirms the hypothesis that students may experiment some improvements in the perception about networking and collaboration. A positive attitude in this dimension would encourage learning but this still needs further validation because there were some students that said they had worked alone.

6.2.2. Creativity and innovation

The students participated in an experience that forced them to develop, implement and communicate ideas to their peers. If the teachers design working sessions where the students have to use strategies like for instance brainstorming for story development, the experience could act as a mediator in teaching these skills.

6.2.3. Critical thinking and problem solving

The work with the videogames made students think in how parts of a whole interact with each other to produce overall outcomes in complex systems. Evidence of this is the diverse components that they had to articulate to complete their projects. This is confirmed by similar studies related to the use of programming tools in the curriculum (Kafai, 1995.)

6.2.4. Media literacy

Students seem to have established the communication needs in the game trough messages that have to be accepted by children and youngsters. So the experience may open interesting educational opportunities to examine how individuals interpret messages differently, how values and points of view are included or excluded, and how media can influence beliefs and behaviors.

To conclude however that these skills are favored by activities as described in the research it is necessary to include in the design of the research experience the appropriate instruments to assess the 21st century skills in students.

Another point of particular importance is a possible link of the creation of video games with education for entrepreneurship because that could be used to mediate the issues associated with entrepreneurship education and also link this with the industry of videogames (emerging in the region.)

6.3. Creating video games of various genres

There is a variety of videogame genres that could be used in a context similar to the described experience. Each of these genres offers particular educational opportunities. The following list presents some typical genres and its possible use in formal education.

6.3.1. Simulation

Creating simulation games requires that the students learn the structure and the laws governing the systems that are being simulated. For example, to simulate the economic system of the “middle age”, the students need to conduct a preliminary investigation to learn all the details of the economic system. Such research could be included in the game design document, therefore the design document will fulfill a role primarily descriptive of the game created.

6.3.2. Action-adventure

In the genre of role-playing game, the action-adventure game involving a design document focuses on the narrative. It is then possible to integrate the writing of this document on the subject of Language through the associated curriculum. The action-adventure games give special importance to the main character in the game, which allows us to associate a "theme" to the character and offer the opportunity to use the activity of creating action-adventure games to mediate curricular learning (e.g. the creation of a historical video game in the History subject.)

6.3.3. Strategy

The strategy games are essentially simplified simulations in which the player is encouraged to set strategies for solving the problems presented in the game. It is common that commercial off-the-shelf videogames are presented thematically associated with historical events (e.g. strategy games on the second world war or the crusades of the middle age,) which is why a first approach to the pedagogical use of that genre would be that students design and implement strategy games in a historic moment and be integrate in the course of history.

6.3.4. Puzzle

This game genre is especially popular because does not require a lot of playing time from the players, which is why it is associated as a genre for casual gamers. Puzzle games usually have a variety of themes and it is possible to find pedagogical opportunities in such themes. For example, students could design and implement a recycling game that requires to decide where to dump different types of waste (glass, paper and plastic.) The development of this type of game is less demanding in design and execution times that games from other genres because the argument must be simple and the objective must be clear, so in practice it would be wise to develop videogame creation projects for primary education.

6.4. Designing a technology curriculum

One of the major problems faced by educational institutions is that teachers do not use the technology resources they have available in their schools. Chile, like many other countries in the world has invested significant resources in technology to be used in education, but it is necessary to unlock the educational potential of these technologies to ensure better use of available resources.

Given the above-mentioned problem and our experience in the Erasmo Escala Arriagada school, we believe that the establishment of a technology curriculum might be the solution for a better use of available technology in the education

system. Further work is needed to generate proposals with respect to the tools that should be used at different educational levels. This requires bringing together the different experiences available and to evaluate them and identify those that present a real value in the teaching-learning processes and also give an efficient use of existing technologies.

The creation of video games has a wide range of educational opportunities and also appears as an attractive alternative for use in the context of technology curriculum, which is why it becomes particularly important to recognize this situation and open new lines of research related to the creation of video games in the school context, this allows us to align the processes of teaching and learning culture in schools with which our students participate and become citizens of this new society of XXI century.

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