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From MMORPG to a Classroom Multiplayer Presential Role Playing Game

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ABSTRACT

The popularity of massively multiplayer online role-playing games (MMORPGs) has grown enormously, with communities of players reaching into the millions. Their fantasy narratives present multiple challenges created by the virtual environment and/or other players. The games' potential for education stems from the fact that players are immersed in a virtual world where they have the opportunity to manipulate and explore, thus motivating the construction of knowledge. The interaction and collaboration between participants allows students to exchange information, test their understanding and reflect on what they have learned. Given the promising results of using MMORPG technologies for educational purposes, this paper translates the multiplayer role playing game (MRPG) aspect, the essential concept behind MMORPGs, into the classroom context. We present the abstraction behind a *Classroom Multiplayer Presential Role Playing Game* (CMPRPG) and the development of a CMPRPG for teaching ecology. The game has a quest structure in which each result highlights a key teaching objective. It is implemented at a high level, with interaction between reusable game elements defined using triggers. It is observed that the implemented CMPRPG has appropriate usability levels, benefits the learning and application of the concepts of ecology and, in the interactive dimensions, it encourages participation and collaborative narrative structures among participants.

Keywords

Learning, classroom, multiplayer game, MMOG, virtual worlds

Introduction

The convergence of high-speed Internet connections, increasingly sophisticated graphics cards and powerful microprocessors has driven the appearance of many video game titles that are now omnipresent in our culture, particularly among children and adolescents (Delwiche, 2006; Rhyne, 2002]. This phenomenon has led to much research and debate over the educational potential of these games (Mitchell & Savill-Smith, 2004). Some studies have concluded that video games develop skills such as high-level thinking, reaction times, visual attention and literacy (Delwiche, 2006) while others have unearthed evidence that long exposure to video games can diminish brain activity, create emotional and behavioral problems (Mori, 2002) and even increase aggressivity and violent conduct (Anderson & Bushman, 2001). Researchers have also raised gender concerns in that females have been found to display less positive attitudes towards technology use (Young, 2001) whereas males devote much more time to video games (Bryce & Rutter, 2003; Griffiths & Hunt, 1995). Even so, a significant inflow of women to the video game market has been detected (ESA, 2009; Yee, 2001). This entire debate will no doubt grow in the future with the ongoing expansion in the number of video game players.

As research proceeds on their educational possibilities, video games continue to incorporate the latest technological innovations in the push to further their development and capture ever more enthusiasts. Perhaps the best example at present is the highly popular World Of Warcraft (Cohen, 2008), that belongs to the genre known as massively multiplayer online role playing games, or MMORPGs (Bessière, Seay & Kiesler, 2007). MORGPGs are characterized by: their fantasy environment that favors immersion and flow (Csikszentmihaly, 1990), the interactivity with the virtual world and peers through the virtual world, having a history and a structured script in challenges and missions that develop critical thought, teamwork, and problem-solving strategies (Dickey, 2007), as well as the generation of new situations produced by the interaction of players (Steinkuehler & Duncan, 2008).

This type of game is dependent on two main technical considerations, Internet connection speed and computer graphics and processing capacity. These factors are essential to the development of high-quality detailed virtual environments that large numbers of players can connect to and thereby interact with other players and the virtual environment through fictional characters they invent for themselves in a fantasy narrative filled with challenges created by the environment and other players. These virtual environments share a number of characteristics with

interactive learning environments (3-D technologies), whose emergence has been propelled by the integration of this type of technology with educational materials and an epistemological shift towards the ideas of constructivism.

It is these common characteristics that underlie the extensive analyses by many researchers into the educational potential of MMORPGs. The theoretical assumption behind interactive learning environments is that students construct understandings through interaction with information, tools and objects in the environment as well as collaboration with other students (Dickey, 2007). To motivate this construction in interactive environments, they must be able to manipulate and explore (CTGV, 1990; Jonassen & Rohrer-Murphy, 1999). MMORPGs are built as 3-D spatial representations that allow players to move and interact in simulations of fantasy or realistic environments.

Conversation, discussion and collaboration are also important in learning environments for their contribution to negotiation, socialization and learning (Lave & Wenger, 1991), allowing students to exchange information, test their understandings and reflect upon what they have learned (Duffy & Cunningham, 1996; Jonassen & Rohrer-Murphy, 1999). Most MMORPGs are social environments where players communicate, collaborate, plan, design strategies and socialize with other players. Finally, learning environments must have the ability to pose interactive challenges that require players to synthesize, analyze and evaluate information and apply critical thinking to formulate strategies and solve problems. MMORPGs provide many opportunities for such challenges through the narratives created in this type of game (Dickey, 2007).

The objective of this paper is to present an adapted MMORPG to the classroom needs, denominated "Classroom Multiplayer Presential Role Playing Game" (CMPRPG), and an experience to teach ecology with CMPRPG. The following work introduces the fundamentals CMPRPG concepts; we then presents a CMPRPG to teach ecology within the framework of Chile's 6th grade school curriculum and describe its technical implementation. Afterwards, we present the exploratory study results carried out with students. Finally, we discuss these results and submit our conclusions.

CMPRPG: MMORPG for the classroom

Given the promising results of using MMORPG technologies for educational purposes, this work translates the multiplayer role playing game (MRPG) aspect, the essential concept of MMORPGs, into the classroom context. Since the number of students in this context is not massive and play takes place within a single room rather than on the Internet, we have changed the terms "massively" and "online" to "classroom" and "Presential" respectively, thus giving us the new designation "Classroom Multiplayer Presential Role Playing Game" (CMPRPG). This game type involves all of the students in a class playing at the same time in a virtual world projected onto the walls of the room in which each student interacts through an individual input device (e.g., mouse).

MMORPGs use virtual worlds to create immersive interactive environments where players participate simultaneously to achieve personal and group objectives, which are fundamental aspects of motivation according to Yee (2006). The essential contribution of MMORPGs to interactive learning environments is thus their support of intrinsic motivation. Game developers have succeeded in motivating players to extreme levels, even to the point of addiction. This issue has also been widely studied, and the main factors found to lie behind this phenomenon are a player's character in the narrative and the quest model (Dickey, 2007).

Research into the importance of players' characters in the intrinsic motivation of a game (Stone, 1995; Turkle, 1995; Curtis, 1997; Reid, 1994; Jakobsson, 2002; Jakobsson and Taylor, 2003) demonstrates that players invest much time in differentiating their characters by gaining experience points that allow them to add and modify character attributes. Due to the time limitations inherent in a classroom context, our CMPRPG model excludes the ability to save a particular instance of a game and continue it later with the same characters, unlike MMORPGs in which a virtual world continues indefinitely. The differences between the characters available in CMPRPGs are directly related to the roles players can choose.

According to Luff (2000), successful role identification helps the student escape the confines of contemporary norms and beliefs. The players are forced to change perspective and see the world differently. Bell (2001) notes that the ability of role-playing techniques to affect attitudes and behavior has been fully demonstrated. As with many

MMORPGs, roles in CMPRPGs are chosen at the start of a game and develop automatically in accordance with the behavior of the players during the virtual world activity so that the incentive to differentiate their characters as they wish is maintained, at least temporarily.

The nucleus of an MMORPG design is the narrative, the game's background story. It is made up of a series of mini-narratives known as quests. Generally, people have difficulty understanding and remembering information received out of context or a long time before they can use it (Barsalou, 1999; Brown, Collins & Duguid, 1989; Glenberg & Robertson, 1999). Quests provide information to players moving through a world as and when they need it, supplying indications on its meaning and how it applies to that world (Gee, 2003; Delwiche, 2006).

A quest allows players to interact with the system by interacting with the narrative, presenting them with characters, missions, information related to the missions, etc. This interaction has three principal objectives. The first is to expose the players to various resources (information, tools, objects), particularly those that are key to advancing in the game. The second is to provide the experience needed to further the development of their characters, expressed in terms of a score that determines the level and attributes the character may choose at a given moment in the game. Finally, the third objective is to stimulate collaboration and strategy development by generating new quests that require multiple players to complete (Dickey, 2007).

The multiplayer aspect of MMORPGs makes individual players part of a community, and through their participation in it they understand the world and themselves from that community's perspective (Delwiche, 2006; Gee, 2003). In CMPRPGs the community is created through students' classroom interaction, thus facilitating group work, discussion, collaboration, etc. This social interaction allows ideas to be exchanged for the construction of knowledge, a fundamental factor in educational development (Cole & Stanton, 2003). When individuals work together on a given problem they communicate and mobilize knowledge, energy and motivation (Zurita & Nussbaum, 2004). However, the mere fact people are working in the same environment will not guarantee such collaboration (Nussbaum et al, 2009); to ensure it is achieved, CMPRPGs must enable interactivity and include the necessary tools to foment group work and discussion through a game's narratives.

As for virtual environments, they immerse players in the game through a narrative defined within a certain context. Studies have demonstrated that immersion in a digital environment can support education in at least three ways: by allowing players to observe phenomena from different perspectives, by placing them in locations and contexts where the phenomena are occurring, and by facilitating transfer, defined as the application of knowledge learned in one situation to another situation (Dede, 2009). In CMPRPGs the use of 3-D technologies and cameras to define which virtual world zones are displayed at a given moment allows phenomena to be shown from different perspectives as needed to aid in their understanding. Also, the narrative and the environment situate the players in the place and context where phenomena occur, providing them with the information and tools that will have to be used there. The concepts to be delivered are thus communicated at the appropriate time and place so that players can use the information and knowledge acquired in a simulation that closely resembles the real world, thus shortening transfer distances.

A CMPRPG for teaching ecology

Objectives

In this section we introduce a CMPRPG for use in teaching ecology. The teaching objectives of the game are the ones laid down by the Chilean Ministry of Education for the 6th Grade course in Nature Study and Comprehension (Mineduc, 2004), and are shown in Table 1. These objectives can be divided into two categories: 1) transversal objectives, which refer to the general training of students in moral and social conduct; and 2) vertical objectives, which involve the acquisition of skills in specific areas of knowledge and personal development and are defined for specific courses and curriculum levels. The table also indicates the associated teaching activities, that is, the educational activities that facilitate the analysis and comprehension of a given knowledge or skill to be taught. Finally, the table includes the expected learning, i.e., the knowledge and/or skills that students should attain by the end of the educational or classroom experience (Mineduc, 2002).

Table 1: Teaching objectives

Transversal teaching objectives	Vertical teaching objectives	Teaching activities	Expected learning
To promote collaboration, responsibility and personal autonomy. To use knowledge and be able to select relevant information. To promote initiative and teamwork	To describe and comprehend the processes of flow and exchange of material and energy between living beings in a hypothetical ecosystem.	Notions of dynamic ecosystem equilibria are applied to given situations: prey and predator. Notions of rupture of the ecosystem equilibria by natural factors are applied to given situations.	Ability to recognize the material and energy flows that occur in food chains and webs.

Quests

The ecology game includes a number of different quests following the CMPRPG model, each one designed to emphasize a key teaching objective. They are arranged linearly so that the end of one marks the beginning of the next. This order is determined by the curriculum structure set by the Ministry of Education and ensures that the course concepts are delivered incrementally.

Three of the game's quests are aimed at achieving specific vertical objectives (Table 2). In the first Quest, a new foreign species joins the ecosystem. This new predator starts feeding on the predators that were previously at the top of the food chain transforming the ecosystem. The players must protect the ecosystem by scaring away the new species; to do this they must approach the new predator species en groups of not less than three players so as to lead it away from the playing zone.

In the second Quest, a strange parasite starts to affect all the animals and it turns into an epidemic. The players have to contain this epidemic. To do this, two roles are defined in the game, the hunter who paralyzes the infected animal, and the Shaman who later cures it.

In the third Quest, there is an explosive reproduction of the herbivorous population becoming a risk to plant life. In the virtual setting, the plant ecosystem is comprised of three areas, and its existence is at risk from this increase in herbivorous predators. The players must work together to prevent these herbivores from destroying the ecosystem by killing off plants in each one of these three zones. The players must plant more plants, kill the herbivores when they become too numerous and ensure that there are always carnivorous predators in each zone.

Table 2: Game activities and related teaching objectives

Description of activity	Specific vertical objectives	Expected player behavior
Quest 1: A foreign species is introduced into the ecosystem breaking the ecological equilibrium.	1.1. To characterize the food chain of the carnivorous predator.	Observe that tigers feed on bears.
	1.2. To recognize human involvement in achieving ecological equilibrium of the secondary consumer.	Control and eradicate the tigers before they eliminate the other species.
Quest 2: An epidemic spreads among the animal population.	2.1. To recognize the action of the parasite.	Observe that the animals are being weakened by a virus.
	2.2 To recognize human involvement in the control of pathogenic parasites.	Control and eradicate propagation of the virus by curing or destroying infected animals.
Quest 3: Deer reproduction rises to plague proportions.	3.1. To characterize the food chain of the herbivorous predators.	Observe that herbivores feed on plants.
	3.2 To recognize human involvement in achieving ecological equilibrium of the primary consumer.	Encourage hunting of deer to control their population.

Chile's 6th grade primary school curriculum states that, in addition to achieving vertical objectives, the teaching activities need to be aimed at transversal objectives (Mineduc, 2002). In the Ethical Formation field, the collaborative work in the three Quests enables players to exercise increasing degrees of freedom and personal autonomy. In the Personal Growth and Empowerment area, collaborative work enables the participants to distinguish and chose relevant information to the task as a group, as well as exercising the ability to express and communicate opinions in order to reach an agreement. In the area of Person and Environment encourages the protection of the natural setting as a human development context through the development of personal initiatives and team work.

The optimum interdependency of actions between peers that ensure meeting activities objectives and the the game's aim: i.e., to recover or preserve the ecosystem's equilibrium, is shown in Table 3.

Table 3: Activity-collaborative strategies relationship

Activity Description	**Collaborative Strategies** (Optimum Interdependence)
Quest 1	The sum of players' actions in groups of three in the three virtual zones defined in the game, help frighten off or eradicate the predator to protect the ecosystem. This implies awareness of the problem, of one's own role and willingness to add actions between peers that help achieve the goal.
Quest 2	Only a set of actions in groups of two players – first the Hunter immobilizes the sick animals and then the Shaman performs the cure – enables epidemic expansion control. This implies awareness of one's own role, use of information that will allow the ranking of actions, and willingness to dialogue that will enable recognizing the pertinent actions in each case.
Quest 3	Player organization and their distribution over the three different spaces of the virtual environment ensure the efficient care of the entire ecosystem. This implies understanding of the problem, personal autonomy and responsibility in upholding the group agreement that ensures the goal is achieved.

Implementation of the CMPRPG

Technical considerations

The activities were developed using the 3D NeoAxis engine, modified in order to be used with the Multipoint SDK (which uses a more recent version of .NET).

The ecology game is processed on one PC with a single graphics output device and multiple input devices to allow interaction between the student players. This was achieved using Microsoft Multipoint SDK, which supports processing independently the information captured by the input devices (Pawar, Pal & Toyama, 2006). Thus, each player can have his or her own pointer controlled by a mouse in order to interact with the system. In the implementation we used regular mice, because Bluetooth and wireless mice experienced technical difficulties: using more than four wireless devices caused interference and poor device performance. Bluetooth devices, in turn, have a restriction in terms of the number of devices per antennae (they support up to seven devices), which, together with the impossibility of using in Windows multiple drivers for different antennae, becomes an insoluble problem.

Among the benefits of this single-computer design are its low cost and portability compared to a setup using separate machines for each player, which would require multiple computers in a dedicated room.

The game can support a maximum of ten players. This is due mainly to the space restrictions within the virtual world given that the players' characters must be displayed on the same output device, thus limiting visible space.

Game elements

The players are assigned to one of two roles, hunter or shaman. Each of them has a particular ability and needs the other to perform properly. Both roles have four attributes in common: life points (the amount of harm players

experience before dying), energy points (for exercising special abilities), speed of movement, and attack (harm inflicted on animals when attacked). Hunters are more adept at hunting and thus have more highly developed attack, life point and speed attributes than the shamans. The latter, although weaker than hunters, have the ability to cure other characters (hunters or shamans), and in doing so consume their own energy points. The two groups are interdependent because they require each other to carry out complex tasks. The players must constantly feed on animals and plants or die of starvation. The animals are either herbivores or carnivores, the former eating plants and inoffensive to players and the latter eating other animals and aggressive toward any character that approaches. The animals also reproduce periodically. A description of each game element is given in Table 4.

Table 4: Elements of the Ecology Game

Type of element	Description	Specific element
Map	Contains the complete set of elements that define the activity.	
Characters	Represent the players in the virtual world. They have four attributes: life points, energy points, speed of movement, and attack.	Hunters: most highly developed attributes are speed of movement, life points and attack. Shamans: are able to cure their allies in exchange for energy.
Animals	The principal source of food for the characters. They must also eat periodically or they will die. They can reproduce.	Herbivores: Deer. They feed on plants and are inoffensive. Carnivores: Tigers and bears. They feed on other animals and are aggressive toward characters.
Plants	Static objects that reproduce periodically. They are consumed by herbivores and by shamans to regain energy.	
Decorative objects	Purely aesthetic. They provide a realistic setting for the game.	These objects include trees, rocks, smoke, etc.
Zones	Define three-dimensional spaces in which the game's actions take place.	Sphere, cube
Items	Objects that can be collected or used by the players.	Food

Figure 1 shows the different described elements for the Ecology activity in a snapshot of the overhead projected image in front of which the students interact face-to-face..

Figure 1: Snapshot of the implemented CMPRPG

Elements of interaction

Interaction between the various game elements occurs by means of triggers, a model used in commercial games such as WarCraft III. Triggers consist of events, conditions and actions, and function according to the following logic: if an event occurs and certain conditions are satisfied, a given action is taken (El-Nasr & Smith, 2006). A trigger is thus initiated by an event, which may be any of a variety of situations that arise during an activity ranging from a user input to changes in an element state such as the death of an animal, a player or some other game unit.

An array of different actions may be exerted on game elements as a result of the occurrence of an event together with the satisfaction of the associated conditions, including interface functions (*e.g.*, the display of a message) and actions to control game units and characters. For example, in the second quest the players must frighten off the tigers who invade the ecosystem, but they will flee only if they are pursued by at least three players. In this case, the event is the entry of players within the zone of a tiger, the condition is that the players number more than two and the action is that the tiger retreats to the point furthest from the players within a radius defined by the game editor.

The main advantage of programming with triggers is that they can be used to define the interactions between game elements in a high-level language. A further advantage is that the specific rules of an activity are defined as elements and are therefore reusable for creating other games. In Figure 2, we exemplify the interaction between one participant and the elements of the game, performing the action of attacking a group of animals. This snapshot is contained in Figure 1.

Figure 2: Player attacking a deer

Exploratory study

Objectives and methodology

An exploratory study was carried out with three objectives: a) To measure the learning on the defined ecological objectives, b) To determine the type of communicative interaction that is attained among students, and c) Perform a usability study.

The study involved 10 students from the 7th grade, in regular Primary school, ages ranging from 12 to 14, in a mid-level socioeconomic school of Santiago de Chile. Children from 7th grade Primary School were chosen because; a) they are already aware of the ecological equilibrium and food chain concepts as these are included in their study plan from the previous year, and b) the designed Quests are applicative; namely, knowledge of the balance concept and the food chain is a pre-requisite – although not necessarily the understanding of such-.

Procedure

1. Two days prior to the session using the CMPRPG model, the command of prior knowledge on the ecological equilibrium of all players was evaluated, using the NEE (Notions on Ecological Equilibrium) test, which was built

for the vertical objectives of the presented CMRPG . The test that was reviewed by three primary school teachers, experts in this subsector of the school curriculum.

2. On the day the CMPRPG model was applied the following series of actions was performed:
- An interactive tutorial of the CMPRPG was developed, to delimitate a) the games structure and objectives, b) the meaning of the elements on the screen, and c) the use of the mouse so that each player can interact with his/her peers through their avatars.
- Following the tutorial, the game activities were initiated. At the end of the 3rd activity, the researcher team gathered general impressions on the game from the students.

3. Three days after the CMPRPG session, the group was evaluated using the NEE test.

The usability conditions of the CMPRPG were recorded on a Usability Observation Scale (Table 6) by two bystanders. Additionally, the session was filmed using two fixed cameras for subsequent analysis of communicative interaction (Table 7).

Exploratory Study Results

Notions on Ecological Equilibrium Test Results (NEE)

Taking into account that the activity permits working with 10 students simultaneously, this number of participants were used in the pre-test session and in the CMPRPG activity. However, only 8 students were able to take part in the post-test evaluation – 5 females and 3 males – the remaining two members being sick. Consequently, the comparative analysis of the results of the NEE pre and post test was performed on 8 valid cases. Table 5 shows the Mean and the standard Deviation in the 8 cases used in the study.

Table 5: Descriptive statistics results of post-test in the Notions on Ecological Equilibrium (NEE) Test

Test NEE	Mean	N	Standard Deviation
Pre-test	7,4	8	1,3
Post test	7,9	8	0,8

It may be observed that in the post-test, students increased their score in the NEE test. Compared to the pre-test, the scores obtained by the 8 cases rose 7%, this being a non significant difference of p=0.227) reaching a medium effect size of (d_{Cohem}=0.50). Likewise, analyzed independently, both females and males increased their scores in the post-test, where a slightly higher increase was observed among the males (14% in males and 3% in females).

Usability Results

The usability of the CMPRPG was assessed through observation scales adapted to each of the teaching activities raised in the Quests. The designed items evaluated three aspects of usability:

1. *Identification of map elements*; refers to items that assess to what degree the students were able to recognize the dynamic, contextual and informative elements regarding their participation in the map.
2. *Activity Understanding*; refers to the items that assess to what degree the students were able to play the game according to screen instructions and use the action possibilities of the character chosen to address the Quests.
3. *Activity participation among players* refers to items that measure the existence or not of collaboration with others through the game character and its respective emotional expression.

The usability of the Tutorial was only evaluated for Aspects 1 and 2. Aspect 3 - *Activity Participation among players*, was not considered because it is an activity that is guided by the system so that students learn to operate the game. The various items of Aspects 1 and 2 were coded according to the following scale: 0 = Not achieved; 1 = Achieved with help; and, 2 = Achieved alone. The items regarding Aspect 3 were coded according to the following categories: 0 = Does it; and, 1 = Does not do it.

The behavior of each game player was observed and classified through the items of each of the three indicated dimensions. Subsequently, the scores obtained by the group in each item and then in each dimension were tallied. For purposes of analysis, these were converted to percentages, where the 0 tendency means no usability and the 100 tendency indicates full or adequate usability. Table 6 presents a summary of the usability achievement percentages by the group of players in each activity presented.

Table 6: Quest Usability achievement percentage in each usability dimension evaluated

Usability aspects	**Achievement % Tutorial**	**Achievement % Quest 1**	**Achievement % Quest 2**	**Achievement % Quest 3**
Identification of map elements.	87,5	91,1	100	100
Activity Understanding	83,8	80	72,5	40
Activity Participation among players	Not applied	65,7	60	45

Table 6 shows that the Tutorial offers adequate initial information to students for the identification of the map elements and for activity understanding. Over the course of the session, the usability measures in the three dimensions reflect variations associated to what is called for in each Quest's.

As the game progresses the identification of map elements improves, but not so the understanding nor the participation among players. This affects the success achieved in each Quest. Quest 1 was played three times; however in the three opportunities the students did not reach the objective of maintaining ecological equilibrium. Quest 2 was played twice; the first time they failed, but the ecological equilibrium objective was achieved on the second run. Quest 3 was played only once and the students did not reach their objective of maintaining the ecological equilibrium of the virtual ecosystem. The usability level of the 1st dimension, *Identification of map elements*, reached 100%, and the remaining 2nd and 3rd dimensions tended to drop. This occurred because, as map element identification improved the students became more independent in terms of screen information on how to address the Quests, and their interaction in class did not transfer to their character's activities on the screen. The 3rd dimension, *Activity participation among players*, was particularly impacted by the absence of coordinated actions between the players. On the other hand, in all activities the players clearly evidenced satisfaction and positive emotion about their involvement in the game.

Interactivity Results

The Quests set had an approximate duration of 35 minutes. Quest 1 took approximately 20 minutes, Quest 2 took 10 minutes and Quest 3 lasted for 5 minutes. The ten participants interacted amongst themselves as well as with the map elements shaping different communicative interchanges.

Table 7: Communicative type interchanges

Definition of Interchange Types
Incomplete Interchanges: Interventions (statements, affirmations, actions) that are independent of the activity or hegemonic narrative between speakers in the classroom, and does not constitute a dialogue with any specific speaker or with the group.
Interchange of Information: interventions and actions aimed at solving absences of functional information for individual actions. This involves at least two different interlocutors in the dialogue. In the CMPRPG activity, the other spokesperson can be a specific player, the group or the activity map.
Negotiation: Interventions where speakers state two or more excluding action strategies that seek to converge into new strategies.
Leadership: Intervention by one of the players who organizes the action of one or more players.
Coordination: two or more players narrate in order to share interdependent actions on screen with an aim to achieving an objective.

From a pragmatic and interactive perspective, the interchanges consist of interventions from different speakers in a dialogue. There are different types of interchange or dialogue units according to the objective. Not all interventions constitute dialogues; although they might have a communicational intentionality; in which case they are defined as *Incomplete interchanges.* The collaborative work is a blend of interchange structures where the speakers build actions of interdependence through their interventions (Atencio, 2004; Ivinson & Duveen, 2005). In this case, the collaborative work is a blend of interchange structures such as: Negotiation, Leadership and Coordination. Table 7 defines the types of interchange that are analyzed in this activity.

In turn, different variants and categories for achieving the objective can be internally identified in these types of interchange. Although a majority of student interventions became dialogs related to the proposed activities, as in the case of *Information exchanges*, the latter did not achieve the same success level in order to become collaborative dialogues. Table 8 shows the categories *Interchange of Information, Negotiation, Leadership and Coordination*. It can be seen that of the 46% of interventions linked to collaborative dialogues, only 22% were successful – the *leadership* and *coordination* categories-. Likewise, it can be seen that the males, compared to the females, had more Incomplete Interchanges and Leadership; and the females stand out in *Interchange of Information* and *Coordination*.

Table 8: Frequency of interventions corresponding to student interchange types and categories

Types of interchange	**Categories**	***Percentage of Interventions***	***% Male***	***% Female***
Incomplete Interchanges	Statements and actions that are not linked to the activity, nor are directed to any speaker or group.	6%	10%	3%
Interchange of Information	Question/answer narratives regarding information on game usage between two specific interlocutors.	33%	31%	36%
	Question/answer narratives regarding information by one speaker to the whole group.	9%	10%	8%
	Player interaction with screen instructions.	6%	3%	8%
Negotiation	There are differing opinions among the players on how to address the activity and no agreement is evidenced.	4%	4%	4%
	There are differing opinions among the players on how to address the activity and agreement on a new strategy is evidenced.	0%	0%	0%
Leadership	One player indicates tasks and/or roles to others but there is no evidence that peers have followed these directives.	6%	8%	3%
	One player indicates tasks and/or roles to others and it is evident that peers have followed these directives.	13%	15%	10%
Coordination	One player states his/her intention of sharing actions with another player in order to reach a goal, but they do not define the complementary nature of their actions.	15%	10%	20%
	One player states his/her intention of sharing actions with another player in order to reach a goal and they define the complementary nature of their actions.	9%	10%	7%
	TOTAL	100%	100%	100%

Discussion

The use of the CMPRPG model integrated, in a structured and entertaining manner, a set of activities aimed at achieving transversal and vertical teaching objectives of the school curriculum. The exploratory study demonstrates that the proposed activities motivate the participation of the students and promotes team work. The game enabled

visualization of the food chain and the ecological equilibrium concepts. Even more complex is the understanding of the consequences of human actions, the handling of which the virtual world enables through different scenarios. For example, in Quest 3, the student eliminated all the bears from the virtual ecosystem and that triggered an excessive increase in deer. When the student was asked the consequence of his/her actions, the student said that there would be an increase in deer and this would provoke a decrease in plants, and, in addition that the air would get worse; this latter element was not even considered in the game.

The analysis of the usability results suggests the need to calibrate the growing complexity of the Quests. Simplifying the relation between concepts, in our case the ecological chain, can benefit coordinated participation in the game.

The ethnographic observation of the session and the analysis of the interchange structure demonstrate that there are qualitative differences in the participation. The male players demonstrated greater leadership and emotional expression during the game as compared to the women. The female participation was more oriented towards obtaining information, interaction with the events on the map – interchanges of information-, and actions oriented to coordinating actions.

The participants failed in achieving their goal in two of the three Quests. The collaborative interdependence indicated in Table 3 for Quests 1 and 3 did not occur. Both Quest 1 and 2 have two common elements for achieving the objective: a) that the participants organize in groups of at least three players, independent of their characters' attributes and b) agree with the other participants to delimit an action zone. In Quest 2, the basic element of collaboration is the organization of players in partners with different roles . It is up to future work to explore whether collaborative relationships requiring the coordination of fewer participants (whose roles are defined by the attributes of their characters) would increase the possibility of success in this activity.The difficulty for students to successfully address all the Quests does not lie in the understanding of the task but rather in the coordination of actions. The students understand that, for example, it is better to spread out in zones to protect the ecosystem, but they have trouble putting this into practice. In a future work, a way to solve these problems should be researched, developing effective mechanisms of communication and reflection.

In on-line games, the players have two ways of communicating: text and voice. Text messages are generated only between two people or among a sub-group of players. This helps in guiding the communication more effectively which is not possible in a CMPRPG model. Verbal communication in the classroom was, at times, chaotic. This was because the students are not used to being responsible for organizing their communication given that this is usually done by the teacher. This was demonstrated negatively in the last activity where the relevant information could not always be communicated effectively, which led to its failure. A future study should research if the systematic and periodic use of the CMPRPG model develops this personal-presence communicative skill.

At the end of each Quest a reflective activity was carried out. The objective of this reflection was oriented towards showing and ensuring that the teaching concepts were assimilated by the students. During this reflexive activity, the students became so wrapped up in the screen elements that these paradoxically became a distracter of the actual reflexive activity. A future study should analyze how to use virtual world elements together with the reflexive work performed by the teacher.

Additionally, time in the classroom is limited, as opposed to on-line games where the players have more time at their disposal. This implies that although it is expected that the collaborative activities should emerge naturally – as in on-line games – the time constraints in the classroom need guided reflection to ensure and step up the achievement of transversal and vertical objectives. The leadership actions observed in students dissolved in a communicative context that was at times chaotic. A mediation action is needed to strengthen the collaborative strategies that emerge from the group. With regard to the above, an opportunity emerges for the teacher to participate actively as a reflexive mediator of the teaching processes.

The use of computerized supports increases the learning time needed, this being due, on the one hand, to the time required to understand and dominate the virtual world, and on the other because as the students are participative actors of their own learning they require more time for their interactions. In our first experience, this required a minimum time of 60 minutes. It is recommended therefore that CMPRPG models be used to work academic contents that have greater time assigned in the curriculum. Thus, fuller advantage could be taken from the collaborative dimension promoted by the use of a CMPRPG model.

The results of the exploratory study must be understood considering two methodological limitations. One of them is the absence of a Control Group; although we found that learning increases after the test, we ignore whether such improvement would also have been achieved with the same exposure time but using traditional teaching methods. The second limitation has to do with the different devices used by each participant; these were devices wired to the central computer that restricted student mobility and thus their collaborative possibilities. Future studies should consider analyzing learning compared to a control group and using wireless devices, so as to allow greater participant mobility.

Conclusions

In this article we introduced a new tool denoted CMPRPG that is derived from the concept of a MMORPG and can be used in the classroom to achieve immersion in an educational activity and collaboration between students via a MRPG with curriculum content. We found that the structure of a quest facilitates the development of a series of curriculum objectives through a ludic language and concluded that, for future CMPRPG designs, it is recommended that: a) the conceptual relationships to be worked out be made operational through a process of increasing complexity; b) the students be offered more time for practicing and commanding their characters' attributes in the virtual world; and, c) the teachers' role in the deliberation of the learning content applied to the game be defined.

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