Report of the Workshop

Gaming and the scientific mind- Designing games to develop the scientific mind

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Introduction

Videogaming and the development of the scientific mind

The necessity of fostering learning and the development of the scientific mind calls for the exploitation of all the available means that may contribute to a life-long process of development and renovation of the scientific mentality, in both an individual and collective way, and in a situated manner, transcending formal educational contexts and scientific environments.

Amongst such means, digital games deserve a specific attention. In fact, gaming and games (especially digital games) engender a huge potential to allow enhancing learning processes and contributing to the development of the scientific mind. Such potential can be approached and understood from two different perspectives: playing games and making games.

From a player's perspective, playing videogames can be conceptualized as a problem-solving activity that requires learning in order to progress and achieve the goals of the game. In fact, players are engaged in activity that resemble scientific processes, since they are required to identify/define problems to be solved, hypothesize and plan solutions, figure out how to use the available resources, and test the hypotheses, carrying out the planned courses of action through game playing activities.

From a game designer's perspective, making games can be seen as an activity that requires transdisciplinary team efforts to create, plan, test and discuss ideas in an iterative way, in order to understand the dynamics and elements involved in game playing, and design a system which the player will have to interact with.

To exploit this double-faced potential, it is necessary to acquire knowledge regarding the phenomenon of gaming, and how games can enhance learning and contribute to developing scientific thinking.

The problem: understanding gaming in order to exploit it

Game analysis is a common approach to understand the potential of digital games, as proved by the current literature. However, analyzing games is not a simple task: it requires a considerable effort and time investment, which is often hardly compatible with the possibilities of those who might be interested in exploiting gaming and digital games for serious purposes.

Things can be even more problematic if the analyst is not a gamer, in which case the lack of specific, gaming-related experience and knowledge can severely hinder game analysis efforts.

Hence, it is necessary to ensure that game analysis activities are supported by a proper minimum background of gaming-related knowledge. How can this knowledge be acquired, if not through traditional training?

Understanding the potential of gaming through game design

Understanding the basics of game design can be a good way of efficiently acquiring knowledge essential to tackling game analysis efforts without being a game expert (like gamers, game designers/developers or game researchers). Games are systems, which can be determined or complex, depending on the specific game contents, rules and toys (game mechanics) that are part of the game, and on the number and roles of the players that participate in the ludic activities. Hence, designing a game means designing a system, and system design skills are certainly not prerogative of game experts. Furthermore, we believe that even a basic knowledge of game design can provide good bases to:

- Analyze and understand specific games.
- Understand how specific products can be exploited with "serious", learning-related purposes.
- Speculate about what to look for in digital games, possibly contributing to the design of new games, interacting with field experts.
- Understanding how the very same process of game design is a learning process that must be tackled with a scientific mindset, and can therefore be used to engage other learners and generate relevant learning achievements.

All this motivated us to hold at the BtSM 2009 "**Gaming and the scientific mind - Designing games to develop the scientific mind**"**,** a game design workshop specifically crafted for non field experts. This paper reports on the goals and organization of the workshop, and discusses the most relevant aspects of the experience, analyzed through direct observation of the session, and through comments and remarks offered by the participants.

The workshop

Objectives

The workshop was aimed at involving people with little or no gaming-related expertise in a game design experience, in order to allow them to enhance their understanding of gaming and game design activities, and their connection with learning processes and the development of scientific thinking.

Hence, the workshop was articulated in two parts. The first part was shaped as a seminar, aimed at illustrating to the participants the foundations of game design. The second part was a structured collaborative group work, aimed at involving the participants in a hands-on game design process, to allow them enhancing their knowledge and understanding through concrete game design practice.

Organization of the workshop

Initial instruction of the participants: the foundations of game design

The activities of the workshop were preceded by a seminar on game design. The seminar dealt with fundamental principles that must be followed in order to provide to players challenging and rewarding experiences, allowing them to develop a sense of mastership on the virtual world in which the game is set.

Hence, the session was initially focused on analyzing the cornerstones of quality in game design: the context of the game, mostly defined by the game's setting and storyline; the goals of the game; the gameplay, i.e., the activities that must be engaged in, in order achieve the goals; and the playability of the game, i.e., how well the game allows players to understand what must be done, and how and when to do it. The analysis stressed the primary importance of designing the gameplay and the tools that the player can use in order to carry out the gameplay activities: the toys of the game, also known as game mechanics.

The session was then focused on the examination of several commercial products, in order to exemplify the application of the analyzed design principles in simple but yet very successful games.

In conclusion, a schematic view of the game design process was proposed to the participants, in order to provide them with some kind of guidance for the activities that they had to undertake.

Goal and organization of the group work

The goal of the game design group work was to create a new game starting from two pre-existing games, combining and modifying their game mechanics, gameplay activities and related rules, and/or creating entirely new ones. No constraints were imposed as to whether the games had to be digital or analog.

In order to achieve such goal, the participants chose to work in a single group. Hence, the game design activities were carried out in a fully collaborative and incremental way, starting from an initial proposal and building onto it, through a series of iterations focused on gameplay activities, game mechanics and rules. Each iteration was based on specific contributions proposed by some of the participants, which triggered a debate eventually leading to the acceptance, rejection or modification of the contribution.

Participants could rely on the support of game design and instructional design experts, who acted as facilitators, providing expert opinions and "scaffolds" useful for the progress of the activity, and to enhance the efficiency of the collaborative work.

Besides acting as facilitators, the experts monitored the activities to assess emerging outcomes not explicitly addressed/provided by the participants.

Dynamics of the activity

Group work setup

The day before the workshop, participants were required to identify simple games, based on a maximum of five rules, in order to contribute to the workshop. No details were provided as to what would be the purpose of their proposals, and no constraints were imposed as to whether the games should be analog or digital.

Formalization of the group work goal

During the workshop, after the seminar session, the participants contributed their game proposals, and they were explained that the goal of the game design group work was creating a hybrid game, based on the game mechanics and gameplay activities of two of the proposals. No constraints were imposed as to whether the game to be designed should be analog or digital.

One of the participants proposed the activity of "crossing the street" as if it was a proper game. Much to the surprise of other participants, the facilitators remarked that the activity proposed had indeed the nature of a game, so much that it was the basis for the design of a very successful videogame of the past: *Frogger*™[1]. .

As a challenge to the audience, the facilitators proposed that the group work goal be to hybridize *Frogger*™ with the popular *Checkers* game, which triggered reactions of perplexity from some of the participants. Support was provided by the facilitators in order to illustrate how, if the focus of the design process was set on gameplay, game mechanics and related rules, even such diverse games had affinities that could make the hybridization process possible. The proposal was eventually accepted, and the group work goal was set.

Formulation of the base proposal

The group work began with the proposal of a base idea for the final game. After a brief initial reflection, the first proposal came from the participant who proposed the "crossing the street" activity, and was fairly well articulated, in terms of gameplay activities, mechanics and rules.

The essence of this proposal relied on *Checkers* as the main game to modify, and considered *Frogger*™ as the game to take ideas from. The key idea was modifying the original *Checkers* game to enhance the checkboard mechanics, endowing its rows with movement to interfere with players' progress (thus taking inspiration from the mechanics of the cars in *Frogger*™). The proposal "broke the ice", triggering other participants' comments and reflection, although, at first, the proposal was neither explicitly accepted nor rejected.

At this point, facilitation was provided in order to give an implicit "thumbs up" to the proposal, explaining why the idea was an effective hybrid of *Checkers* and *Frogger*™. This was done analyzing the proposed system based on the concepts discussed during the initial game

[1] *Frogger*™ requires the player to control little frogs in order to bring them home safely. To achieve such goals, the frogs must cross dangerous areas, such as swamps and streets. In the case of the streets, the frogs must cross jumping from the top of one vehicle to another, avoiding being hit by vehicles in case they fell on the street.

design seminar. The facilitation also made participants understand that they could indeed perform similar analyses, even without being gamers or field experts. Hence, most participants "jumped on the wagon", overcoming an initial "game design shyness". This marked the beginning of a true collaborative activity, and the initial proposal was implicitly accepted as the base proposal to work onto.

Group work startup: collaborative analysis of the base proposal

After the intervention of the facilitators, the participants began analyzing and discussing the base proposal. No alternative designs where proposed, and the discussion was initially focused on the chessboard mechanics. Participants analyzed how it could affect the gameplay and the gaming experience, testing it and assessing its complexity, playability and how challenging it would be for the player.

Once this analysis was completed, participants started an incremental and iterative design process to enhance the base proposal. They focused mainly on how the chessboard mechanics could be further enhanced to improve players' experiences in term of challenge, reward and mastership. Facilitation was provided to allow participants to think, analyze and evaluate the gaming system as if they had to play the game, and to properly apply basic game design principles.

Incremental collaborative game design process

The game design process saw an increasingly proactive involvement of all the participants, who engaged in the activity with a high level of motivation, as if designing a game was a game itself. The process was quite well structured, and organized in iterations which produced incremental tuning and evolution of the game design.

Each iteration was triggered by a specific new proposal, or critical analysis of something that had been proposed but was considered unacceptable (possibly after an idea was tested). In spite of the variety of issues dealt with, and the lack of gaming-related expertise, group members usually came up with contributions totally compatible with the evolving base game proposal, thus contributing to a truly constructive and collaborative process.

Analyses and proposals normally stemmed from assessments and reasoning regarding the challenges tackled by the player, and the skills required to play the game. This lead to designing features that were more and more demanding and sophisticated, requiring to players analytical and planning skills.

Facilitation was generally aimed at focusing participants' attention on specific topics that emerged from the group work, triggering constructive discussions and leaving to the participants the responsibility of drawing their own conclusions and making decisions as a team. More specifically, facilitation was required to keep the focus of the discussions set on one issue per iteration, and make sure that iterations led to concrete decisions and evolutions of the game design. Furthermore, facilitation helped in making sure that the increasing sophistication of the design did not translate into excessive complexity, potentially leading to players' frustration.

Due to time constraints, the iterative process did not lead to the completion of the game design. However, the facilitators deemed the partial results to be interesting and polished enough to be tested with real players.

Discussion

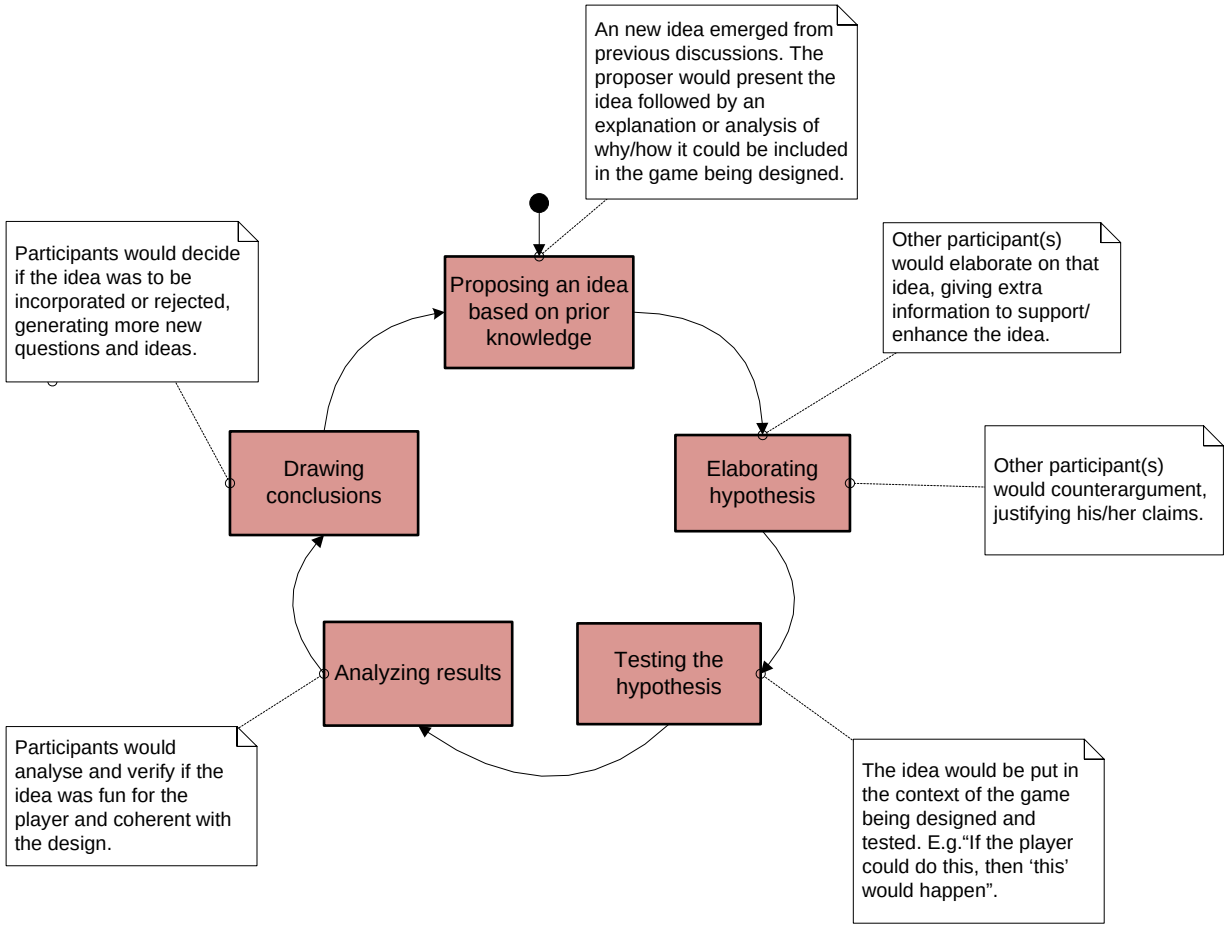
The process of game design

The participants of the workshop showed high levels of motivation and engagement during the game design process, regardless of personal backgrounds, age and expertise. Even if not all of them participated in the same way, and some of them were shyer than others in presenting their ideas, there was a general atmosphere of active participation and involvement.

After the game design session, some participants expressed that they felt "closer" to digital games. This is possibly a consequence of understanding better what games are. In fact, game design processes require designers to comprehend games from both a functional and structural point of view, embracing a systemic analytical approach. Hence, understanding that games are indeed systems can allow non-experts to see games as something that can be dealt with, regardless of the lack of specific, gaming-related expertise. Through the workshop, participants could also experience the importance of collaboration when creating a game. Emergent ideas were constructively received and analyzed by the members of the workgroup, generating a propitious climate for open discussion and debate. Thus, participants had the opportunity to understand the potential that designing games has for the development of the scientific mind by collaboratively constructing knowledge, challenging others' ideas, and establishing shared procedures and practices.

In addition, participants could appreciate the iterative nature of the game design process. During the group work, as new ideas and problems were presented and discussed, new solutions emerged and more new ideas arose, leading to a chain of design iterations. This iterative dynamics has been described by the literature as lying at the heart of any game design activity. Furthermore, such dynamics is one of the main sources of creativity in the design process, since the circular and ongoing flow of ideas gives birth to a creative cycle which emphasizes a permanent activity of identification of problems, and formulation, implementation and testing of solutions.

The nature of the iterative design process is strongly related to the role that digital games can play to foster the development of the scientific mind. At the end of the workshop, facilitators analyzed the activity with the participants, evidencing that they had engaged in discussions that had, in general, the following structure:



In sum, participants could experience directly what type of processes take place during the game design activity and how they resemble proper scientific processes. Therefore, it was evident to participants that the learning potential of games is not limited to playing games, but also encompasses benefits deriving from the game design process. Consequently, participants could see that it is feasible to use game design activities to enhance learning, and that this is not circumscribed to digital games, but is proper of any game design process.

Nonetheless, to ensure that the game design activity generates the desired learning outcomes, it is important to rely on the guidance and facilitation of experts in the field of game research and development.

The potential of gaming

Through designing a game, workshop participants had the opportunity to approach and understand games from a new perspective. Being responsible for designing an experience that players should engage in, they were forced to put themselves in players' shoes. In doing so, they could understand more concretely the cognitive processes that players undergo while playing a game, and what "playability", "challenge", "reward" and "mastership" actually mean to players.

Thus, participants could better envision the potential that game playing can offer to develop

the scientific mindset, and how it is possible to create good videogames that are very fun to play, while at the same time promoting learning. Furthermore, they understood the importance of true transdisciplinary efforts, and how the synergy between game researchers/developers experts of other domains could allow designing high quality serious games, transcending the boundaries of currently available products.