

A Model for the Design of Digital Epistemic Games

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Abstract

This paper relates to an empirical study about the use of ICT for the design of playful learning situations. The study aims at addressing the following question: Which elements should be taken into account for the game design in order to enable the learner/gamer to be engaged in epistemic activities?

Our research methodology is design-based, iterative and collaborative. We designed Clim@ction, an online multiplayer role-playing game which allows French and Canadian secondary students to design an innovative project for the implementation of "green" energies in their territories. The data collected during the study permitted us to propose a three-dimensional model which includes the key factors that should be taken into account in order to implement a Digital Play-Based Learning approach.

Keywords

model for game design, digital epistemic games, epistemic interactions, digital play-based learning, sustainable development education

INTRODUCTION

Play-Based Learning is now considered to be an alternative pedagogy adapted to new learners which allows designing complex, authentic and realistic learning situations. This paper relates to a research project about the use of ICT for the design of *digital epistemic games* that simulate a real context in order to offer the learner/player the opportunity to deal with complex situations and *ill-structured problems* (King & Kitchener, 1994). By being immersed in an authentic situation and having to solve realistic problems, it is expected that students will learn the "*ways of acting, interacting, and interpreting that are necessary for participating*" in real situations (Shaffer, 2006).

In this paper, we describe an empirical work dedicated to identifying the key factors that should be taken into account to design a digital epistemic game, as a realistic and authentic situation which allows the students to face complex problems. We propose a three-dimensional model (Enrol-Entertain-Educate). This model intends to introduce a first answer to the pending questions: Which elements should be taken into account for the design of the game in order to enable the learner/gamer to be engaged in epistemic activities?

DIGITAL EPISTEMIC GAMES & EPISTEMIC INTERACTIONS

There is a growing body of research that focus on Digital Play-Based Learning and there are arguments advocating the consideration of the contexts (Steinkuehler & Duncan, 2008) or the situations (Sanchez & Jouneau-Sion, 2010) rather than the game as a digital artefact. From this stems the possibility of focusing on the interactions that emerge from the situation, rather than on the game itself (Mitgutsch, 2007). Following Shaffer (2006), we propose to avoid the widely used term serious

game and we prefer the expression digital epistemic game to name playful situations designed with digital technologies that intend to foster epistemic interactions.

Epistemic interactions are explanatory and argumentative interactions that play a role in the co-construction of scientific knowledge (Ohlsson, 1995). A majority of traditional academic tasks focus on finding the right answer to a closed question. Consequently, there is a risk that students develop a dualistic vision of knowledge such as "I know" or "I don't know". In opposition to this, solving open-ended and ill-structured problems by playing a game means exploring, accepting uncertainty, coping with a diversity of solutions and establishing judgement. Ill-structured problems are related to higher levels of epistemic beliefs (Jonassen, 2000; Schraw, Dunkle, & Bendixen, 1995) that are important for 21st century citizens who will have to face an ever-complex world. The project "Jouer pour apprendre en ligne" relates to digital epistemic games that intend to represent realistic and authentic situations and that address complex problems for students. In this paper, we discuss the results of the part of the project dedicated to the game-design of Clim@ction, an online multiplayer role game about sustainable development that we designed for secondary students.

Different models for game design have already been developed (see for example Marne, John, Huynh Kim Bang, & Labat, 2012). However, they usually focus on the design of the game itself. Our approach is different as we try to adopt a different perspective that focuses on the design of the situation and the impact of the choices made on the learning process. Therefore, one of the aims of our research project consists in identifying the elements of the design of a digital epistemic game that permit to foster epistemic interactions.

RESEARCH METHODOLOGY

The research methodology consists in a Design-Based Research approach (Wang & Hannafin, 2005). This methodology combines the design of a digital epistemic game (Clim@ction) and the analysis of its impact on the learning process. This analysis is based on the confrontation of the a priori analysis of a digital epistemic game and the results of its implementation in a regular classroom. The methodology is iterative and involves a strong cooperation between researchers and secondary teachers. The teachers are co-participants for the design of the game and its implementation in the classroom. They are also involved in the data analysis and in the discussion of the results. Different focus groups permit to discuss the choices made for the design according to what happened in the classroom. These choices are discussed in respect to the data collected (1) during classroom observations, (2) from tracks of students' interactions on a digital platform, and (3) students' focus groups. We intend to produce both pragmatic and theoretical results that account for, and potentially impact learning, in a naturalistic setting (Barab & Squire, 2004).

Clim@ction is an online multiplayer game about land-use management and sustainable development designed for secondary students (15-16 years old). The first year 64 students were involved and, for the second year of the project, 96 students from France and Quebec participated. The students use an online platform to collaborate and to find better ways for producing and using energy in their cities. The online platform allows the students to get information, to ask questions to experts (teachers), to compete and to cooperate with peers. The students also carry out fieldwork using augmented reality in order to test the relevance of the proposed solutions on the field. Mixing simulation and reality aims at designing an authentic and complex learning situation in which students have to deal with environmental, social and economic issues.

Clim@ction is a role play game. (1) The students define "companies" specialized in implementing green energies (solar, wind-wheel...). (2) The "companies" design a pre-project under the supervision of the "official representatives" and under the con-

trol of an “association of citizens”. (3) There is a presentation of the pre-projects during a face-to-face session and (4) the projects are reshaped according to the feedbacks got during the presentation. The “official representatives” are responsible for delivering grants and the “association of citizens” organizes (5) a final vote for choosing the best project and the winning company. The play lasts 8 weeks. It is integrated into the school curriculum (1.5 hour per week).

In this article, we discuss the proposals formulated by researchers and teachers regarding the game design in respect to the data collected from classroom observations and from the students’ tracks recorded on the platform. Figure 1 indicates the agenda of the project.

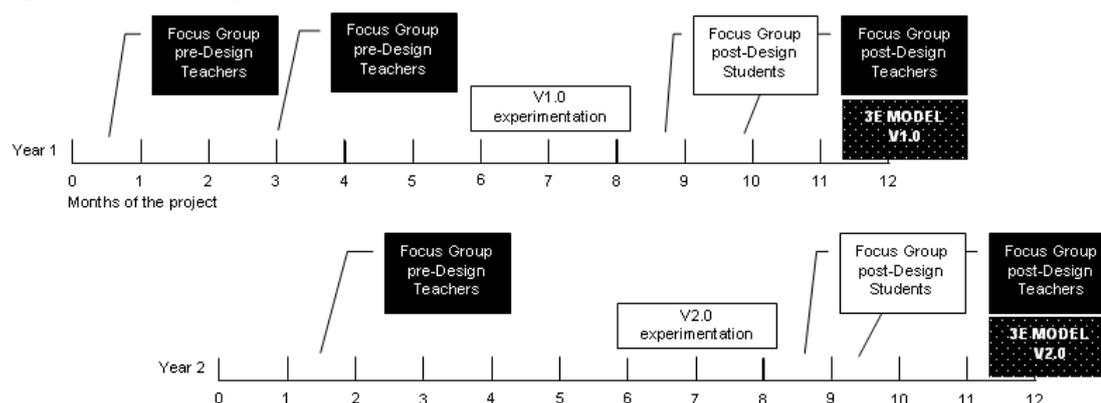


Figure. 1: Agenda of the Project

The focus groups (online or face-to-face) with the teachers have been recorded. They permitted to take decision regarding the design of the game (pre-design focus groups) or to discuss the relevance of choices made for the design of the game after the classroom experimentations (post-design focus groups). The focus groups with students were carried out in the different schools with a sample of students involved in the game. They permitted to get information from their enrolment into the game, their feelings about the gameplay and the impact of the game on what and how they learnt

A THREE DIMENSIONAL MODEL FOR THE DESIGN OF DIGITAL EPIS- TEMIC GAMES

We developed a three dimensional model (Figure 2) to describe the key factors for the design of the situation that have been identified by researchers and teachers and confirmed by the data collected from students’ tracks and students’ focus groups. The first dimension includes the elements that are crucial to Enroll the students into the game. The second dimension relates to the play factors (Entertain) that make possible that the lived experience is fun. The third dimension (Educate) encompasses the epistemic dimensions of the game. The model is called 3E model. In the following we briefly describe these different dimensions.

Enrolling the Learner/Player: Competence, Autonomy and Relatedness

Enrolling the learner/player means fostering his/her motivation to participate. According to Ryan & Deci (2000), students’ motivation results from different universal and innate needs that include the needs for competence, autonomy, and relatedness.

Students feel competent when the level of difficulty is adapted, when they have to reach clear goals and to face a motivating challenge. We made substantial efforts to clarify the objectives of the game since the preliminary versions of Clim@ction. These goals make possible that the students take decisions that are driven by their consciousness of the situation rather than the teacher’s expectations (Ahuja, Mitra,

Kumar, & Singh, 1995). For the first version of the game, some students expressed that they were discouraged by the difficulties to overcome and this problem was taken into account by making different changes. The consequence of these changes was a better feeling of competence expressed by the students for the second classroom experimentation. However, the students expressed that they faced a motivating challenge (“we get into the swing of things”) for paradoxical reasons. On one hand they were happy to participate in a game which allows error without consequences and, on the other hand, they appreciated to be involved in a situation that has the power to impact the “real world”.

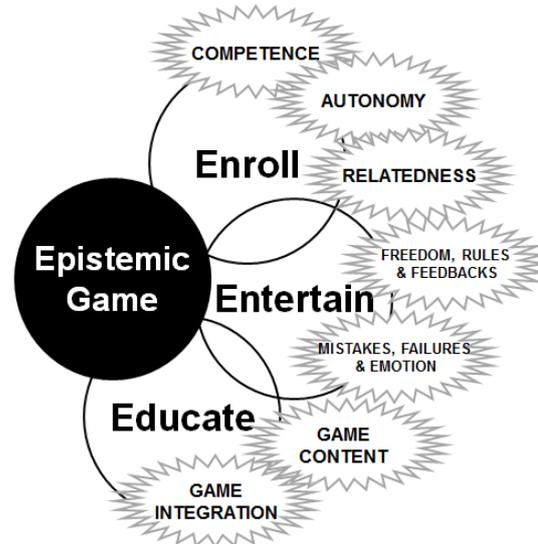


Figure. 2: The 3E model

The students valued the opportunity to benefit from the freedom to take their own decisions. They appreciated being “autonomous” (i.e. not under the control of the teacher). Indeed, we observed that the different “companies” adopted different strategies to be convincing. Autonomy also depends on the capacity to assess the assumed strategies and the feedbacks are crucial. Thus, most of the time devoted to the design of the game was dedicated to imagining how to implement feedbacks. For *Clim@ction*, the feedbacks come from the resources of the platform, from peer interactions and from the teachers. At any time, they allow the learner/player to evaluate the relevance of his/her decision.

The need for relatedness entails competition, indeed, “game worlds are meritocracies” (Reeves, 2011). Besides, during the project presentations, the learner/players were eager to express counter-arguments to convince the “official representatives” and the “citizens” that the presented projects had different deficiencies in terms of environmental, social or economic consequences. *Clim@ction* tends to foster competition, but, for one of the game sessions, the different “companies” agreed that the solution could not result in choosing a unique solution and decided to create a joint venture to propose a more realistic project for their city. Collaboration is another facet of the need for relatedness.

Entertaining the Learner/Player

Entertaining the player is the main objective of a game and pleasure results from many factors such as the feeling of freedom, the level of control offered to the learner/player, the rewards gained in such a situation, the opportunity to make errors without consequences and the possibility to play a new role.

Freedom means that the player/learner is allowed to take decisions and to shape his own strategy and the level of control offered to the learner/player relates to the amount of events that occur according to his/her decisions. Empowering students to

think like designers, to organize themselves within the game and to express their own creativity makes them autonomous and capable of acting in the role of experts (Kirriemuir & McFarlane, 2004). During the focus groups, the students expressed that they appreciated the feeling of freedom during play in contrast with what they called a “normal class”. Rewards are the ludic dimension of assessment and they are considered extremely important for maintaining a player’s interest in a game’s challenges (Habgood & Overmars, 2006). Therefore, *Clim@ction* allows the learner/player to get rewards throughout the whole game in the form of grants and the final step of the game consists of an election of a winning company. However, the “rewards” mentioned by the students during the focus groups were not the primary rewards embedded in the game but the effect of the game on “real life”. Paradoxically, they mentioned that they were proud to design a project for their local environment and to see the impact of what they did. For example, one “company” was proud to have had a discussion about how to heat the water with the real director of the swimming pool. As a counterpart to freedom there are rules. Rules are a set of norms and conventions shared by the players that limit freedom. Even if rules are arbitrary, they need to be acceptable and relevant regarding the model embedded in the game.

The frivolity is another core characteristic of a game (Brougère, 2000). The learner/player can make mistakes without real consequences and he is encouraged to continue trying (Gee, 2003). The learner/player can project his/her values and desires in his/her character. This character plays the role of a projective identity and assumes mistakes and failures. As actions or decisions in a game do not impact the real world, play occurs in a safe space where the learner/player feels secure. Indeed, during the focus groups, the students often underlined the difference between the “normal class” which generates anxiety because of the risk of getting a bad mark and the game which offers a secure space for trying new ideas and ways of behaving. However, some of them – and it has been confirmed by teachers - mentioned that they felt insecure at the beginning of the game due to the novelty of the situation. Moreover, we observed, for one class, that the play dimension was killed when the students met the real official representatives who expressed their interest in the project designed by the students. In such a context, a mistake could have had an impact and the students expressed that too much pressure was put on them. As a result, it is important to keep in mind that it is important to preserve the frivolity of the game.

Entertaining the learner/player also depends on humour and the teachers themselves used funny costumes during the time devoted to play. Humour appeared to be important to enhance positive feelings and to foster arousal.

Educating the Learner/Player: Game Content and Game Integration

During the focus groups conducted with teachers two scopes emerged regarding the educational part of the game: the game content and the integration of the game into the classroom settings.

As a meta-activity, a game is a model of a given situation and simulating a part of the world allows the player to explore a physical or human situation of this world (Egenfeldt-Nielsen, 2006). Therefore, the relevance of game content is an important issue to address. A “good” digital epistemic game is authentic and anchored in the real world. Such a game ought to be a credible representation of the domain of interest and ought to encompass the appropriate knowledge (Reeves, 2011). The model implemented in a game such as *Clim@ction* results from the transposition of a real situation (a situation of reference) into the context of the game. Therefore, this embedded model is a set of concepts and values selected by the game designer and not reality itself. One of the main elements underlined by teachers was the relevance of the content and its adequacy regarding the situation of reference. This point has already been emphasized by (Kirriemuir & McFarlane, 2004). Indeed, if

the relevance of the content is not guaranteed, there is a risk in encouraging students "to get used to manipulating a system whose core assumptions they do not see and which may or may not be 'true'" (Turkle, 2005). The relevance of the content was also mentioned by the students who appreciated gaining experience from a situation closer to the "real world" than a school situation.

The teachers also indicated that the game was designed according to the curriculum although it was not easy to keep control on the learning objectives due to the freedom offered to the students. A final debriefing permitted pointing out the concepts learned and there was a common agreement among teachers and students to say that the game was adapted to the learning objectives and adapted to the curriculum.

Another important dimension is the link between the content and the gameplay. The required knowledge to succeed in the game should be in line with the pedagogical objectives. For *Clim@ction* the core game mechanisms (gameplay) and the learning content are integrated. Such a game is said to be intrinsic (Habgood, 2007).

The game integration into the classroom settings has also been identified to be crucial. First, the difficulties faced by the teachers and the students demonstrated the importance of benefiting from a sufficient number of good quality computers and from a good organization of the classroom. Second, schools have not been designed for play situations and adopting a Digital Play-Based Learning approach implies making changes in terms of space (the students were allowed to leave the school) and time (due to asynchronous interactions between France and Québec).

Another issue which has been early identified is the role of the teacher during play. His/her role can no longer be the role of a teacher anymore. For the first experimentation of *Clim@ction*, the role of the teacher was not clear and it was identified as inhibiting the gameplay. Therefore, for the further version, the teachers decided to clarify their role in the game and they played the role of experts according to precise rules.

Playtime has also been identified as important during the focus groups devoted to the design of the game. We observed that it is really important to make explicit the limits of the time devoted to play for the students. Keeping the fun during play implies making a clear distinction between the time devoted to play, which should be a real immersive experience without constraints or real consequences, and the time devoted to preparing the play experience or to debriefing. For *Clim@ction*, the beginning of the game is materialized by a symbolic event. The teachers put on the clothes of an expert (a white coat, a tie...) and they wear them during all the game sessions. They put them off at the end of the game. Therefore the borders of the game become clear and it helps the students to enter into and to leave the game. After the play, the role of the teacher is crucial in helping students becoming aware of the implicit knowledge that they use during play in order to solve a specific problem. This step is called debriefing or after action review (Aldrich, 2009). It aims at bridging the game world and the real world in order to make possible the transfer of the knowledge developed during play.

The issue of assessment has been recognized as being paradoxical by the teachers. On one hand, a game entails an embedded assessment used by the player/learner for recognizing achievements and failure. The player can take into account the consequences of his actions and adapt to the situation by applying a new strategy if needed. Therefore, a game can be considered to be a space of reflexivity (Sanchez & Jouneau-Sion, 2010) where the learner/player faces a challenge and can autonomously deal with the situation. On the other hand, by assessing the learner/player from a typical educational point of view, there is a risk of killing the feeling of freedom and frivolity and, therefore, killing the gameplay. The solution adopted for *Clim@ction* consists in the gamification of the assessment process by embedding this process into the game (intrinsic assessment). The assessment pro-

cess entails a set of criteria given to the “companies” and grants distributed according to these criteria.

CONCLUSION AND PERSPECTIVES

The results of this empirical work confirm the complexity of the design process of a digital epistemic game which is supposed to simulate a rich and realistic context. Different elements have to be taken into account. These elements belong to three dimensions that have to be considered in designing both a playful and epistemic situation. (1) Enrolling the learner/gamer consists in fostering his/her motivation to participate and to accept the challenge and it relates to the core characteristic of a game such as autonomy and relatedness. (2) Entertaining the learner/gamer is mainly linked with freedom and the pleasure that the learner gets from playing. (3) Educating the learner/gamer comes from the fact that games are areas for creativity and experience and it is mainly linked with the relevance of the game content and the way the game is integrated into the curriculum.

However, the different elements that we identified should not be understood as isolated elements. They are all linked by complex, and sometimes contradictory, links. Indeed, the paradox of a Digital Play-Based approach lays in the fact that it is sometimes difficult to combine play and serious purposes. Therefore, these different elements should be considered as cursors of a mixing console and it is worthwhile to be aware that moving one cursor has an impact on the other cursors.

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Biography



Eric Sanchez is associate professor at the Ecole Normale Supérieure de Lyon, head of EducTice, a research team of the French Institute for Education and adjunct professor at the University of Sherbrooke, QC (Canada). His research work concerns the uses of digital technologies for educational purposes (e-learning, simulation, serious games).

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