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Meta Serious Game: Supporting Creativity Sessions for Mobile Serious Games

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Abstract:
The early stages of Mobile Serious Game (MSG) design are very complex. That is why many MSG research projects start with a brainstorming session, involving pedagogical and game experts. However, brainstorming with large groups of participants, who come from very different backgrounds, can prove to be long and inefficient. In addition, classic brainstorming techniques are not well adapted to the large number of constraints and technical limitations that need to be taken into account when designing MSGs (e.g. educational content, number of students, duration of field trip, fences). Our hypothesis is that the first stages of design can be efficiently supported by a board game. Indeed, games have proven to be very efficient to support collaboration and enhance motivation and they can be designed in such a way to encapsulate constraints in their game rules. In order to test this hypothesis, we created a meta-SG: a game for designing a botanical MSG for a natural park. The experimentation we conducted with 17 designers was very encouraging. The analysis of the videos, questionnaires and produced scenarios showed that the meta-SG generated a very lively and productive creativity session, and the constraints related to MSG design were not perceived as limitations but as challenging game rules.

Keywords: Serious Game, design, Mobile Serious Game, Collaboration, Board Game

1. Methods for First Stages of Mobile Serious Game Design

1.1 Designing Mobile Serious Games

Designing Serious Games (SGs) for education is a complex process that involves several actors: SG experts, who have experience in using game mechanics to enhance learning, and educational experts, who master the didactics of the target pedagogical skills. The design of Mobile Serious Games (MSGs) requires a third type of actor, who masters the MSG's use context. This context is not limited to a set of measurable physical settings (Dourish 2004); it also contains domain specific notions that can only be identified by ***field experts*** who have a deep understanding of the ***physical context*** (e.g. location, boundaries, physical limitations) in which the MSG will take place. MSGs for museums, for example, need to be designed with a museum curator, in order to fit specific rooms and exhibits (Lonsdale 2005). Another important aspect to take into account when designing MSGs is the ***time context***. For example, if a MSG is designed for a field trip, it must not last more than the time planned for this outing. We therefore adopt a design-based research method (Whang 2005), implying deep collaboration between our team of SG experts, pedagogical experts and field experts. Unfortunately, these experts have little time to offer for work sessions.
As many before us, we were confronted to this problem during the ReVeRIES[1] research project. The goal of this project is to use mobile technologies to help humans recognize the trees that surround them, in a fun and motivating way. It involves SG experts, computer scientists, several botanists and botanical park managers. The main objective of our first creativity session was to help these experts collaborate, in order to produce plausible MSG scenarios, for the *Echologia Park*[2]. These scenarios will be used as a basis to build an authoring tool for the park owners to create their own MSGs. We therefore needed to help the designers in producing a large number and variety of MSG scenarios, adapted to *Echologia's* constraints, and in particular to the park's morphology (e.g. fences, trees) and the park's visitor profiles (e.g. groups of teenagers, families). In the next section, we investigate the strengths and weakness of existing tools and methods for organizing such creativity sessions.

[1] http://www.reveries-project.fr/
[2] http://www.echologia.fr/

1.2 Investigating Tools and Methods Used for Creativity

1.2.1 The Original Brainstorming Method

The first idea that comes to mind to boosts creativity is to use brainstorming. Here are the four guidelines of the original brainstorming method (Osborn, 1954):

> *"1. Criticism is ruled out. Adverse judgment of ideas must be withheld until later. The purpose of the brainstorming session is the generation of many, varied and unusual options.*
> *2. Freewheeling is welcomed. The wilder the idea, the better. […]*
> *3. Quantity is wanted. The greater the number of ideas, the greater the likelihood of useful ideas.*
> *4. Combination and improvement are sought. In addition to contributing ideas of their own, participants should suggest how the ideas of others can be turned into better ideas[…]"*

These guidelines do not adapt well to the design of MSG scenarios. First of all, the guideline 2 seems very difficult to follow. "Wild and unusual ideas", even if they are inspiring, have no use if they are not feasible. There is no interest in designing scenarios that are impossible due to the physical layout of the park, that have ill-adapted educational content or that are technically impossible to develop. Since computer scientists, botanists and natural park owners usually have a very sparse representation of each other's fields, they have to rely on each other to validate their ideas. This is where guideline 1 seems problematic: "criticism is ruled out". Of course, we have to avoid personal criticism, but it is essential for the designers to be free to indicate if a proposal raises incoherencies related to their field of expertise. The third guideline is interesting; a creativity session should produce a large set of new ideas. However, in the context of the ReVeRIES project, there is a trade-off to be made between the quantity of imagined activities and the level of detail with which these activities are described. At the end of the creativity session, we need the activities to be precise enough to propose an executable MSG model.

In practice, very few "brainstorming sessions" strictly obey these rules. Designers usually integrate additional methodologies and tools to structure these sessions and guide designers. In particular, we investigate two tools used for SG design: inspiration cards and personas.

1.2.2 Inspiration Cards

An inspiration card (Halskov 2006) is a physical piece of paper on which either a domain specific knowledge or a technological possibility is described. For instance, in the case of botanical SGs, a *technological card* could describe "augmented reality" and a *domain specific card* might describe "the organization of fauna in families, genres and species". In practice, these cards can be used as creativity bootstrap for various phases of creativity. For example, they can be used to help SG designers construct a shared understanding of the cards content. Designers can also freely associate cards to imagine original SG scenarios. The principle of inspiration cards has been used in numerous design activities such as designing tangible learning games (Deng 2014) or to help designers to integrate game elements in an existing product (Lucero 2010). It is worth noticing that there is no standard for the way inspiration cards should be used, neither for their content.

The concept of inspiration cards seems interesting for MSG design as they help designers in focusing on what is actually feasible while still granting them a lot of freedom in the design process. Moreover, cards are a good medium for engaging collaborative discussions between experts, allowing them to gain a shared understanding of their meaning.

1.2.3 Personas

Personas represent archetypes users of the future system (Pruitt 2003). They are very useful to help designers keep in mind the motivations and needs of future users. Personas can be represented by cards describing a plausible user profile (e.g. name, gender, age, profession, expectations regarding the system...). Giving precise information such as name and age makes the persona more realistic thus helping designers to project themselves into the persona. Personas are often used in Human Computer Interaction (HCI) design.

Inspiration cards and personas seem to be efficient tools to help designers come up with technically feasible and sound scenarios adapted to the park's visitor profiles. However they do not facilitate the design of MSGs that are adapted to the physical and time context of the park. In addition, they are not particularly enjoyable to use and fun essential for boosting creativity sessions (Fullerton 2008). Which leads us to the hypothesis that a game could be appropriate for mediating the collaborative design of MSGs. In this paper, we therefore test this hypothesis by creating a meta-SG: a game to support creativity sessions for botanical MSGs at the

Echologia Park. In the next section, we explain how we transform the design constraints related to this park into game mechanics for the meta-SG. In the third section, we describe how this meta-game was used for a design session involving 17 participants. We then conclude with several perspectives.

2. Transforming Design Constraints into Game Mechanics

As explained in the previous section, MSG design is subject to many constraints: pedagogical, technological and physical. All these characteristics are difficult to take into account without limiting the designer's creativity. We therefore propose to transform these constraints into game mechanics. The main idea is to offer a game that motivates the designers and guides them toward the creation of MSGs that respect all the initial constraints.

Table 1 presents the design constraints for *Echologia*'s botanical MSGs, and how we transformed them into game mechanics. Almost all constraints are related to contextual elements (Chen 2000): user context, physical context, time context and computing context.

Table 1. From design constraints to game mechanics

Constraints related to	**MSG Design Constraints**	**Game mechanics for the meta-SG**
Physical context	*Echologia's* visitors must start at the entrance of the park and finish at the exit and cannot wander outside of the path for security reasons.	The designers use a **board** that represents a map of *Echologia* with the location of its trees (*Figure 1*). The designers use **pawns** to simulate the way the players move along the path. They can propose situated game activities for the players by sticking post-its on the board.
Time context	Previous paper-based games used in the park show that players keep interest in the game if they have regular activities approximately every 10 minutes. If they have less, they lose interest and if they have more, the games seems too long.	The designers can move the pawns 10 steps along the path before they propose a situated game activity and write it down on a post-it. Each step on the map is the equivalent of one minute of walking. This number of steps is adjusted to the players' profiles.
Educational objectives	*Echologia's* MSGs needs to teach the players how to recognise trees and provide information about their remarkable characteristics.	At the beginning of the creativity session, the designers are given 4 **educational inspiration cards**, which they can use to find ideas of game activities related to recognising trees.
User context	*Echologia's* MSGs must be adapted to all the park's visitor profiles (grand-parents, children, adolescents, botanists, tech savvy...)	The meta-SG involves three groups of two designers. Each group is assigned a **persona** for which they need to design game activities. As shown in figure 3, each persona has its own list of expectations regarding the game and movement characteristics.
User context	*Echologia's* MSGs will be played by groups of friends or family members who came to the park to spend time together. It should therefore be designed in order to promote social interactions between players (e.g. collaboration, competition) and physically reunited them, at least every 30 minutes (Syvanen 2005).	All the pawns must regroup on three **gathering points**, marked on the board. At this point, the designers can rethink the game activities they proposed and adapt them in order to add interaction between the players. In addition, the designers are given 4 **inspiration social cards** and 4 **inspiration game-mechanic cards** that can help them imagine original game activities that promote social interaction.

Computing context	As part of a research project in computer science, the MSGs must integrate innovative technologies (i.e. augmented reality, GPS activities)	At the beginning of the design session, the designers are given 4 **inspiration technological cards**.

2.1 Meta Serious Game rules

As shown in *Figure 1*, the meta-SG involves three couples of designers. Each couple is placed around a *board* representing the map of the *Echologia* Park. Each group is randomly assigned to a *persona* for which they need to design a game scenario. They are also provided with 16 randomly chosen *inspiration cards* (4 educational, 4 game mechanics, 4 social and 4 technological) to help them come up with game activities for their persona. The position of the personas is physically represented by pawns. The pawns all start at the entrance of the park and can move along the path of white boxes, until they reach the park's exit. The three groups of designers each take turns in moving their pawn and proposing a game activity by writing it down on a post-it. In order to enhance their productivity, a five minutes time limit was imposed to come up with a new activity. However, they could, at any time, come back on this activity in order to move it to another location or modify it. The meta-game ends when all the pawns arrive at the park's exit. The goal of the meta-SG is to play collaboratively in order to design MSG scenarios that meet the persona's characteristics and expectations.

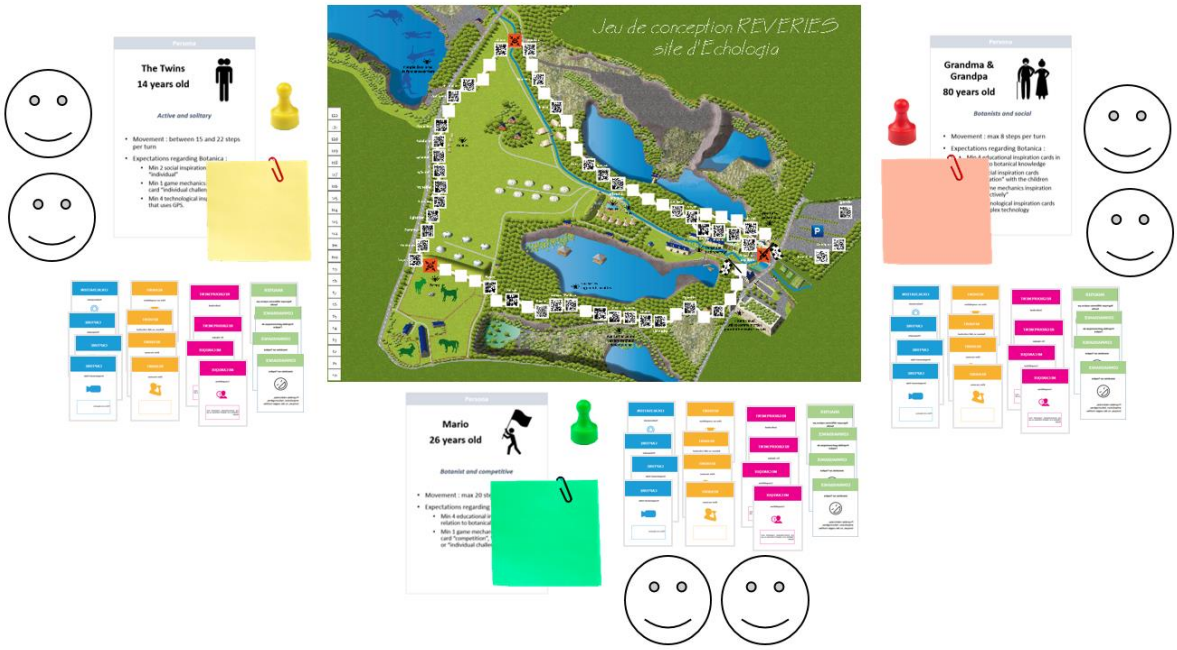

Figure 1. Meta-SG setup

2.2 Board

As described above, the designers work on a board that represents the actual map of the park (*Figure 1 and Figure 2*). The board also indicates the position of trees along the path with a QR Code link to a website with information about its species. Several non-botanical points of interest are also indicated on the board such as the lake or an old lime kiln. The idea is to concentrate all the information the designers might need concerning the physical context on a single map.

2.3 Gathering points

Three gathering points are represented on the board (*Figure 1 and Figure 2*). These were placed, with the help of the park owner, in areas where visitors naturally take a while to rest (i.e. next to farm animals, next to the lake and at the picnic area). When all the pawns are on these gathering points, the designers can take the time to rethink the game activities they proposed and adapt them in order to add social interaction between the players.

2.4 Inspiration cards

As presented in the introduction, inspiration cards, such as the *Jen.cards* (Serna 2015), are a good way of helping designers find new ideas of MSG activities and enrich the ones they have already thought of. At the beginning of the meta-SG, each group of designers is provided with 16 inspiration cards to help them come up with game activities. These cards are to be used as inspiration and not as an additional constraint. As suggested by the *Jen.cards* authors, we selected only the relevant cards for the ReVeRIES project. First of all, we selected 8 out of the 16 existing ***game mechanics inspiration cards*** (e.g. individual challenge, act collectively, negotiation). We also selected 15 out of the 24 existing ***technological inspiration cards*** (e.g. augmented reality, taking a photo, positioning on a map). We used all 7 ***social inspiration cards*** (e.g. individual, collective, cooperation). Finally, we created 11 custom ***educational inspiration cards*** that are meant to help the designers find ideas of situated game activities related to tree recognition. The content of these cards was based on a discussion we had with a university botanical teacher and a paper-based botanical SG she recommended (Marzin 2003) proposing activities such as the identification criteria for species, natural habitat of species or culinary properties of species.

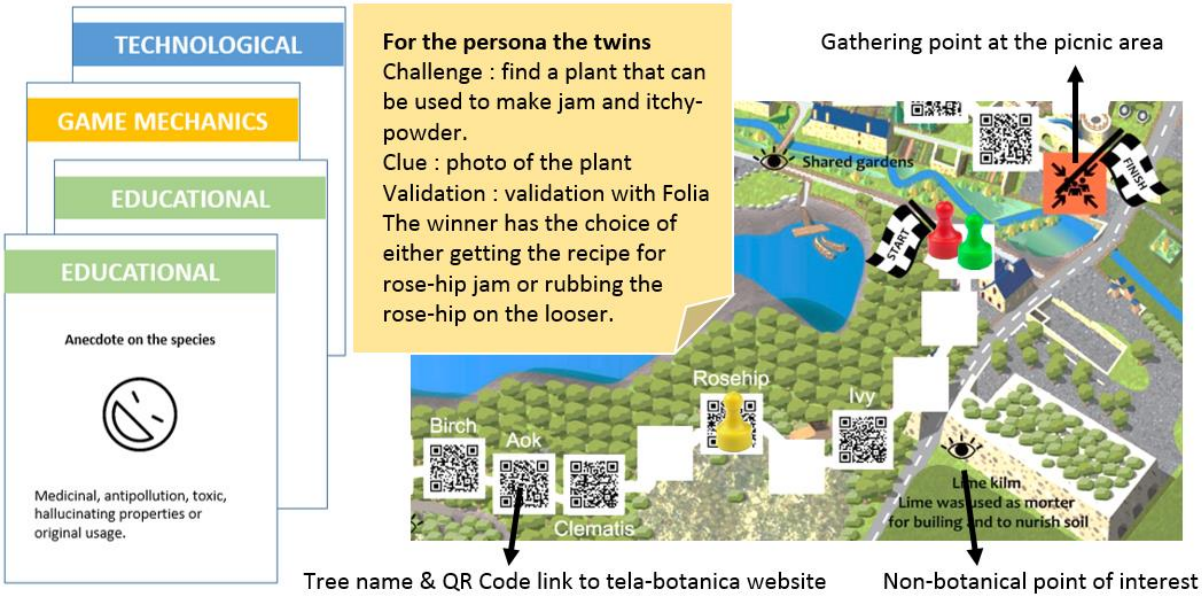

Figure 2. Proposing a situated game activity on the board (close-up of figure 1)

As shown in *Figure 2*, the designers use a post-it to write down a situated game activity for their persona, and stick it next to the location where their pawn is. They can also staple the inspiration cards they used to the post-it. For example, in Figure 2, the designers used 4 inspiration cards to imagine the activity on the rosehip: one technological card (GPS), one game mechanics card (competition) and two educational cards (anecdote about species and culinary properties of species).

2.5 Personas

Each group of designers was randomly assigned one of the eight personas below. These personas represent plausible profiles of park visitors.

- Grandma & Grandpa – 80 years old – botanist and social
- July & Juliette – 18 years old – tech savvy and social
- The children – 8 years old – easy activities and need to be accompanied
- Mario – 26 years old – botanist and competitive
- Mom & Dad – 40 years old – cook and altruist
- The twins – 14 years old – active and solitary
- Peter – 20 years old – tech savvy and solitary
- Aunty Susanne – 35 years old – active et social

Each of these personas also has movement characteristics. For example, the persona “The twins” can move between 15 and 20 steps per turn instead of 10 steps, like other personas. This is because we consider this

type of player as active and therefore eager to run during the game. Each persona also has a list of expectations regarding the game. They are expressed as recommendations for the designer to use inspirations cards when creating the activities for this persona. For example, the persona “The twins” is considered to be solitary, meaning that twins like to be among themselves (Figure 2). In order to help designers in creating a game that respects the personas’ center of interest, we also expressed them as recommendations for using educational and technological inspiration cards. For example, designers are urged to use several technological inspiration cards for the tech savvy personas and, on the contrary, use more educational inspiration cards, related to the culinary properties of species, for personas that are interested in botany.

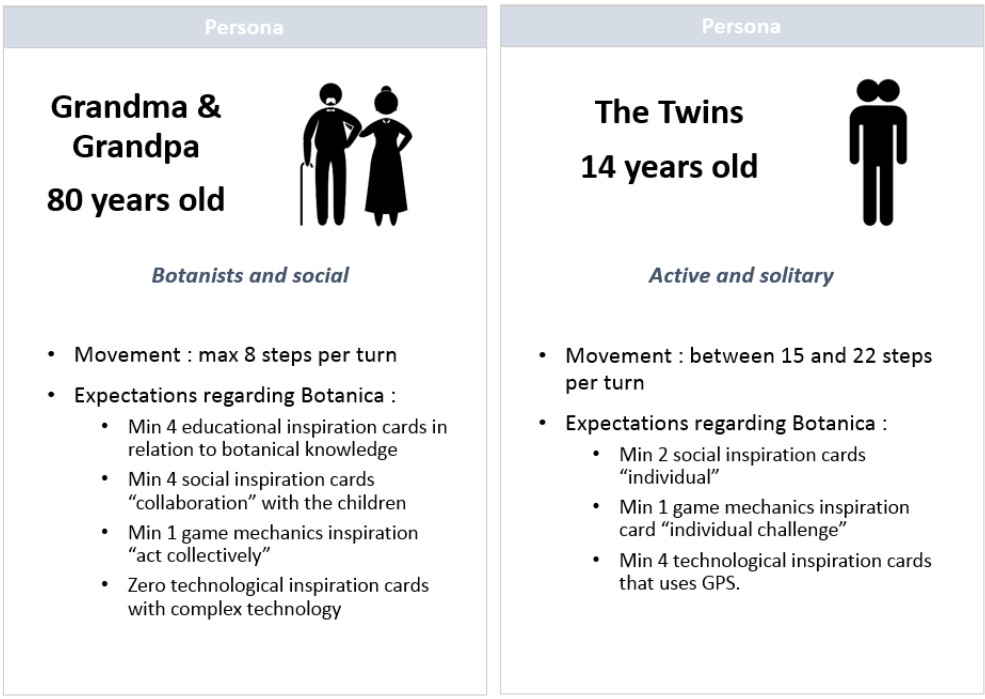

Figure 3. Persona examples

The meta-SG rules and material presented above are the result of a first experimentation with six PhD students. This session allowed us to add several improvements to the initial meta-SG. For example, we simplified the educational inspiration cards by reducing the text. We also decided to add a timer of five minutes to encourage the designers to propose game activities, knowing that they could always alter them later.

3. Validation of the Meta-SG in Real Context

3.1 Experimentation Setup

The meta-SG described above was experimented with 17 designers during the first meeting of the ReVeRIES research project. Before starting the design session, we explained why we decided to use a meta-SG and presented its rules. We emphasized the fact that these rules could be ignored or altered at any time. The 17 participants were dispatched in three groups (A, B and C). Each group was composed of 5 to 6 participants, with at least one botanical expert and one learning game expert. The other participants were computer scientists and offered advice on new types of technology that could be integrated into MSGs (e.g. augmented reality) and guaranteed their technical feasibility. After 90 minutes of using the meta-SG, the designers were asked to present their scenarios in front of the whole group, for further discussions.

The aim of the experimentation was to validate the fact that the meta-SG was beneficial for creativity sessions. In particular, we wanted to make sure the game mechanics created an enjoyable design session and encourage the designer to participate. We also wanted to see if the meta-SG was productive and if the designed scenarios were compliant with Echologia’s constraints. Finally, we wanted to make sure that the designers did not perceive the game mechanics as limitations to their creativity. In order to collect this information, we filmed the sessions to evaluate the participant's engagement, we analysed the produced MSG scenarios and handed

out questionnaire to gather the designer's insight on each game mechanic. In the next sections, we discuss the results for each of these points.

3.2 Result Analysis

3.2.1 Lively Collaborative Design

The video analysis shows that the designers in all three groups were very engaged in the meta-SG (*Figure 4*). During the entire 90 minutes, they exchanged ideas and helped each other to design original game activities. The botanical experts were often solicited to give their insight on the characteristics of the trees that could be used for the activities. Likewise, the SG experts were asked for their opinion on what game mechanic seemed to be best suited.

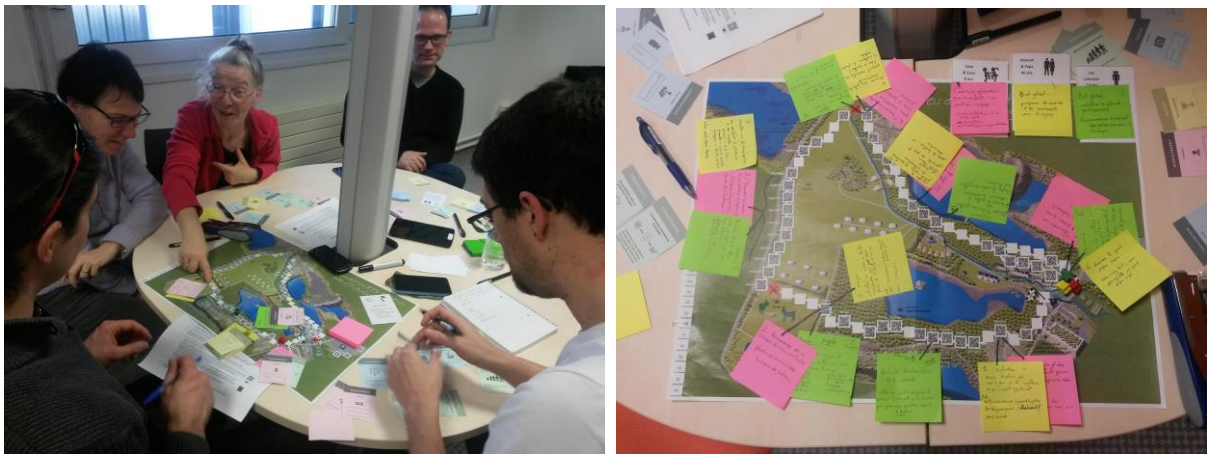

Figure 4. Creativity session with the meta-SG and outcome

3.2.2 Productive Design of Precise Scenarios

After 90 minutes of work, the designers had produced five complete scenarios (i.e. sequence of activities from the park's entrance to exit) and 3 scenarios for the first section of the path. In total, more than 32 game activities were defined. The designers also came up with general ideas written down on post-its and stuck on the side of the board. Consequently, we can conclude that the meta-SG was very productive. Several designers also expressed this feeling orally as shown by this quote of the park owner: "I found the idea very interesting and the design game was very productive".

In addition, the designed scenarios were very precise and very close to a shape that can be implemented as such. The details provided for each activity allowed us to build a MSG model and implement it in an authoring tool prototype. This prototype will soon be tested by the park owner to validate the fact that he can create his own scenarios. Having participated in similar brainstorming sessions in the past, we are positive that such a level of detail would not have been obtained with a classic brainstorming.

3.2.3 Designers Perceptions of the Meta-SG Effectiveness

One of the important points that we wanted to validate during the experimentation was the fact that the game mechanics of the meta-SG did not constrain the designers in their creativity. In this section, we analyse the designers' answers to the questionnaire concerning each game mechanic.

Meta-SG rules - helpful but not enough time

Q1. Did the game rules (3 groups of 2 designers, 5 minutes to find an idea), seem beneficial for the design? Do you have any suggestions?

Among the 17 designers, the majority (9/17) answered "yes", 7 answered "not really" and only 1 answered "no". These quotes illustrate the main feeling: "Organisation a bit complicated at the beginning but useful for the design process"; "I would have been completely incapable of finding any ideas without being guided". However, almost all the designers suggest to increase the 5 minutes delay to come up with an idea.

Board - tree position and points of interest were very useful

Q2. Did the board (real map of the park, tree position and QR Codes), help you to find ideas or, on the contrary, limit your imagination?
Almost all of the designers (14/17) answered "yes", 2 answered "not really" and only 1 answered "no". However, the designers' comments indicate that the QR Codes were used very little. On the one hand, as we expected, the designers preferred asking the botanist in their group for information about the trees. The real map of the park and the position of the tree, on the other hand, seemed very helpful to imagine game scenarios.

Personas - only the name and description were useful
Q3. Did the persona (description, movement characteristics and list of expectations regarding the game) help you imagine activities that are adapted to the various player profiles or, on the contrary, constrain you?
A large majority of the designers (11/17) answered "yes", 5 answered "not really" and only 1 answered "no". The designers' comments indicate that only the name and the two words that described the personas were useful. The movement characteristics and the expectations regarding the game seemed too constraining.

Gathering points - not really relevant to the designers
Q4. Did the "gathering points" help you design a collaborative SG or, on the contrary, constrain you?
The answers to this question show that the designers had mixed feelings about this game mechanic. Out of 17 designers, 5 answered "yes", 5 answered "not really", 2 answered "no" and 5 didn't answer this question because they did not get far enough in the game to use it. Here are two quotes that illustrate these opposite point of views: "Yes, because it allows the family to share their gaming experience, count points if necessary and take off for new activities"; "No, they are quite constraining. I believe that each player feels like progressing at their own pace and imposing these gathering points seems complicated". The analysis of the MSG scenarios also showed that one group decide to move these gathering points a few boxes away because it was more convenient for the scenario.

Inspiration cards - good for inspiration but too numerous
Q5. Did the inspiration cards help you in finding ideas?
Among the 17 designers, 9 answered "yes", 2 answered "not really", 6 answered "no". Mainly, the designers found that "the cards were very useful to find new ideas or complete an existing idea" however, "there were too many cards to look at".

4. Conclusion and Perspectives

In this article, we present meta-SG: a board game that helps designers come up with a large variety of MSG (Mobile Serious Game) scenarios in the early phases of a project. This meta-SG was designed in such a way to embed the numerous constraints of MSG design. In particular, the physical and time constraints related to the MSG's context of use, were embedded into the game's board and rules. Our hypothesis was that the use of such a meta-SG would encourage collaborative and productive interactions between SG experts, pedagogical experts and field experts, who are familiar with the location to which the MSG should be adapted. In addition, we hoped that by transforming the constraints of MSG design into game mechanics, these would not be perceived as limitations to the designers' creativity.
Meta-SG was tested during the initial creativity session of a research project. The aim was to help 17 experts in SGs, botany and natural park owners to come up with a large variety of activities for a natural park. The hypothesis was validated: in 90 minutes, the designers came up with more than 32 detailed game activities that were compliant to the contextual constraints. In addition, a questionnaire confirmed that the designers enjoyed the meta-SG and did not feel limited by the constraints related to MSG design.
Even though meta-SG was designed for a specific SG, we believe the method, we used to transform SG design constraints into game mechanics, are relevant for MSGs in general. For instance, the use of a map that indicates all the potential points of interest and accessible zones, can always be useful for designers. The use of paws, to materialize the player's position on the map, also seems like a valuable tool. The movement constraints (i.e. designers can move their pawns n steps before they propose a situated game activity) can also be adapted to the scale of the map. The other game mechanics should be adapted to the specific constraints of the MSG that is being designed.
The meta-SG concept does have its limits. First of all, the preparation of the meta-SG material is quite time consuming. In particular, we spent a full day visiting the park and identifying all the potential points of interest to create the board. However, we believe this would have been a necessary step, whatever the method used for the creativity session. The other limitation is the fact that the designers need some time to get familiar with

the meta-SG rules and the map before they actually start producing ideas. Our experimentation showed that the designers started writing on post-its after about 15 minutes, which seems reasonable.
As researchers in game based learning, we can only regret the fact that we do not use games to enhance our own creativity sessions and conferences. Meta-SG is a first step towards this objective. Our experience with meta-SG also brought to light another positive effect of using games in the context of interdisciplinary projects: the non-SG specialists, involved in the project, were able to experience the power of SGs for themselves. This experience helped them understand the benefits of using SGs for the project. In the future, we intend on experimenting further by integrating game mechanics to the MSG authoring tool, adapted to the designers' profile.

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