A Creation Tool for Serious Puzzle Games

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Abstract: This article aims to present a tool for designing serious games with riddles, such as escape games. This multilingual tool will be available online freely and presented as a form on a website with a database to save and share one's projects. After completing the form, a graphic overview of the project is presented to the user. It is based on different Serious Escape Games and Serious Puzzle Games realized in the past three years and on several websites giving advice to create this type of activity. This tool is at its early stages and the prototype has been tested by a few Serious Escape Games designers on their previous projects. Feedback will be used to improve the tool. Following the validation of the prototype, computer development has begun: the tool meets the needs of the designers and fits to the different tested projects. Intended initially for teaching after a few requests, it is expected to be used by a wide audience and to respond to the various needs related to the creation of this type of activity.

1 INTRODUCTION

For several years, serious games have regularly been used in the field of education. Many games exist in various fields and their usefulness is no longer to justify. More recently, the Serious Escape Games (SEG) (also called Educational Escape Games), have appeared in this field (Sanchez and Plumettaz-Sieber, 2019; Eukel et al., 2017; Dietrich, 2018; Guigon et al., 2017; Connelly et al., 2018; Pun, 2017) and brought many benefits: cooperation, collaboration, organization, communication, reasoning, team-building, application of the course in a different context ... Indeed, this activity likened to a serious game, is a multi-player life-size escape game, which typically involves escaping from a room or a succession of rooms in a limited amount of time (Borrego et al., 2017). To do this, a group of players must find and collect a number of clues and objects in order to solve riddles (Guigon et al., 2018). However, designing this type of activity is not always easy for teachers which prevents them from designing this type of activity for their students. To overcome this obstacle, we decided to create a tool to help the teachers in the designing process. The problem is to define whether a Serious Escape Game model and its reification into a tool facilitates the design of SEG for teachers? Based on

the previously created SEGAM model (Serious Escape GAme Model) (Guigon et al., 2018) (Figure 1), the tool presented in this article allows to build step by step an educational escape game or another serious game with riddles and to obtain a preview of the organization of steps, riddles and clues. To quickly present the SEGAM model, it is inspired by the DISC model (an acronym for Domain, Interaction, Scenario, Context) created by (Vermeulen et al., 2017; Vermeulen et al., 2019) to produce role-playing serious games with steps. SEGAM kept from the DISC model the separation between levels and the case studies are represented as riddles. Riddles are independent and a red thread is present throughout the scenario, as in the DISC model.

In our knowledge, no model (other than SEGAM) and no specific tool to design SEG have been published. However, there is a real need for it, in particular for teachers and novice designers.

This article propose a tool to co-design SEG with them. A first experiment made it possible to test this tool as a prototype on already realized SEG. Firstly, we present our tool and its features. The second part deals with the testing phase of the prototype and the associated feedback. Finally, we conclude with the perspectives of the project.

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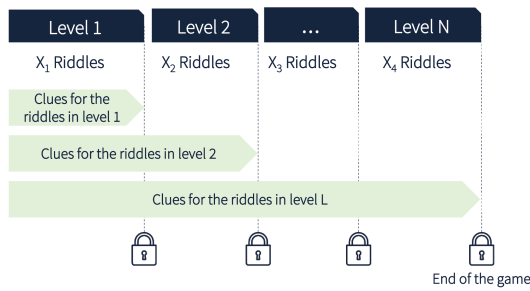[b] https://orcid.org/0000-0003-3646-1741

Figure 1: SEGAM, Serious Escape GAme Model.

2 PROPOSITION

As a result of SEG's growing production, the creation of a tool to structure and collect all the information needed to design escape games quickly became a necessity for many teachers. In addition, most of them have no instructional designer or game designer to help them in this process. When creating such activity by themselves, teachers can get easily overwhelmed by the quantity of information to deal with. A lot of websites give tips and tricks to help build this type of activity but the information is scattered across the web. The tool proposed in this article is therefore intended to guide them step by step so that they can create a serious game with riddles (escape game type) more easily and in an organized way.

The methodological approach used to conduct this research is based on Mandran's work (Mandran and Dupuy-Chessa, 2017): the THEDRE research method for Traceable Human Experiment Design REsearch. This method is based on the improvement process Plan-Do-Check-Act (Sokovic et al., 2010) and thus on iterative cycle with indicators to evaluate the quality of the research. Furthermore, THEDRE was developed for human centered research. In this article, we propose the results of the first research cycle and thus, the first iteration of a tool to help teachers to design SEG.

The prototype (the first iteration of the tool) proposed here first appears as a form (Figure 2) written in HTML and CSS to use it on the web.

Different types of criteria are requested in simple fields:

Pedagogical. The purpose of this section is to define the general educational objective of the activity as well as the skills or learning objectives to be achieved during the course of the game. There may be prerequisites that are important to define beforehand to conceive the riddles. For a serious game, these elements are essential because they will

Figure 2: Screenshot of the tool.

guide all the riddles and help select the content to be treated during the activity. It is important to focus on this aspect as the riddles will be the pillars of the activity and these will be based on the educational content.

Various Constraints. Many constraints are to be taken into account for the creation of this type of activity and will affect in particular the format of the game: the available time, the number of sessions, the number of learners, the place, the budget, the supervisors during the session, etc.

Background. Here, it is a question of defining the global plot, the scenario in which the learners will evolve: what is the initial situation, the goal of the game, what will happen in case of failure ? Are there any important characters in the script? Is the game collaborative or competitive? Keeping in mind that the game can be competitive and educational, several teams fighting for the same goal.

Organization. In this part, the designers will define their project team, information concerning the tests and the reengineering to be carried out before the implementation of the activity. Indeed, the tests are a key step in the design of an activity of this type because the testers (having a profile as close as possible to the target audience) will be able to give

their feedback on the activity and each riddle will then be tested: are the clues explicit enough ? Is there any challenge inducing a state of flow (Csikszentmihalyi, 1990)? This step will also show the robustness of the clues and if the reasoning of the designers is the same as the users'. Then, it is the reengineering step, and thus the changes needed. Some may be done quickly, others may be only done for the next session, requiring more time to achieve them.

Structure. Once the previous elements are defined, the designer will be able to structure his activity: how many steps will be necessary, what will be the riddles that will compose them. The latter will be associated with prerequisites and pedagogical objectives defined beforehand. Another important element is the definition of the clues to solve the riddles: their form, the cost they represent, the step in which they will be discovered in the game and where will they be hidden.

Educational and Financial Report. Finally, once all the elements are defined, the tool offers a financial statement to check that the forecasts for the equipment are compatible with the allocated budget. And there is also a pedagogical review to make sure that all the objectives and skills initially defined are properly treated during the activity.

It has to be noted that most fields are optional, so the designer can only enter information that interest him. Only some information concerning the steps, the riddles and the clues are required because they make it possible to generate the representation with the SEGAM model. Moreover, there is no order to fill the form, the designer can fill the fields in the order of his choice.

Thus, in a second step, thanks to the filled criteria, the model SEGAM is completed with the different elements of the escape game: steps, riddles and clues (Figure 3). Clues referring to the same riddle have the same background color. They can be distributed in the steps preceding the solving of the riddle in question and not only at the step of the riddle to be solved. This brings some complexity for the players who must then use them at the appropriate moment. Notice that the SEGAM model has evolved from its original version and now the term "Levels" is replaced by "Steps"". The term "steps" is more representative because the concept of level could induce a notion of difficulty, which is not necessarily the case from one activity to another.

The tool must be practical and functional, but also intuitive and quick to take in hand in order to be
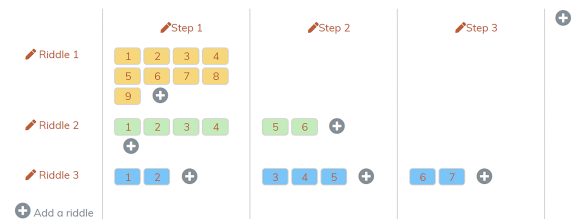

Figure 3: Representation of the project.

used by everyone. Based on the prototype, the first version consists in obtaining a form as complete as possible and meeting the expectations of the target audience (mainly teachers originally). The basic outcome of the form is the pdf export to keep track of the work done or to print it if necessary. A second version is being developed. It will make the tool more ergonomic and easier to use, offering the possibility to add or delete steps, riddles or clues directly from the SEGAM model and affecting the associated fields in the form. Moreover, the technology used to create the tool has evolved in order to have a fast and efficient deployment. Angular allowed that, it is a maintainable framework, with a large community. The project will be easier to manage for the next evolutions. Finally, the tool will remain in responsive design, and therefore easily accessible on smartphones, tablets and computers.

3 TESTS AND FEEDBACK

The tool was tested at first with several Serious Escape Games and treasure hunts made by our team. Three of them were created according to the SEGAM model. The co-organizers of these SEG were the first testers. Then the tests were expanded to other puzzle games not designed with the SEGAM model. Here is some feedback from these tests: Overall, the tool is comprehensive and the user understands easily its operation. He feels guided and all the information necessary to the conception of the activity is present. This tool seems to give inspiration to the designers, discovering fields in the form they did not think about. Here are some improvements for each section of the form:

Background. Basically the activity is intended to have only one end goal, assuming that all learners play for a common purpose. However, by giving them the idea that there may be multiple goals, this can inspire designers to create different scenarios: teams fight for different goals, or some players have different roles and goals from the other players. The target audience of this tool is looking for inspiration

to create such activities and will therefore be fond of tracks for their scenario.

Organisation. It would be interesting to have a checklist in order to make the management of the changes easier in the "Reengineering" part. The progress of the improvements would thus be more visual and practical.

Structure

- In the current version, the possibility of having a clue used in several riddles is missing. This option should be selected in the edition of the clue in the form, giving a multicolored background to this type of clue in the representation with the SEGAM model. Each clue of the SEGAM model would have a different number, except those present in several riddles, which would then be duplicated in the SEGAM model but not in the form.

- If the activity has to be played by several teams simultaneously, it is possible that riddles are nearly the same (to avoid cheating for instance). To save time for designers, the clues and riddles should therefore be duplicable and the possibility of indicating whether a particular piece of data changes from one team to another should be added. Figures 4 and 5 illustrate this possibility with a riddle on logic gates for the purpose of displaying a digit. Indeed, Figure 4 shows the different parameters depending on the groups: Group 1 has the parameters: $a = 0$, $b = 0$, $c = 0$; group 2 has: $a = 0$, $b = 0$, $c = 1$ etc. Thus the diagram in Figure 5 is the same for all, but the electrical signals being different for the three entries, the final solution will be different for each group, while treating exactly the same course notions.

- For the sake of clarity and to decrease the mass of displayed information, it would be wise when you enter the number of steps in the tool, to have the corresponding number of buttons below. Thus, when one clicks on one of these buttons, the part "Riddles" of the form appears. In this way, each riddle is placed in the corresponding step. This avoids having a very long form with all the riddles of the game afterwards, making the navigation very ergonomic.

- Moreover, in the same spirit, the fact of displaying the questions by groups for the riddle part would make this part less impressive by the number of criteria to be informed. Indeed, it would be possible to display the questions step by step and thus the questionnaire would seem lighter and easier to

handle.

- To have a better visualization of the construction of the activity, having the representation with the SEGAM model always visible (on computer and tablet) would help to see the progress of the structure of the game. The designer would thus have a direct return of his actions making easier the reading of the model.
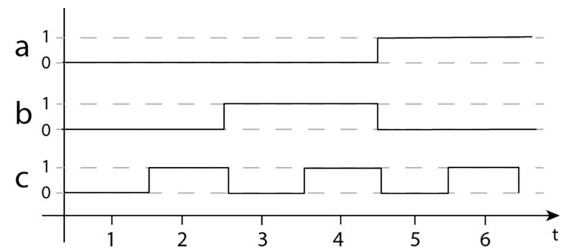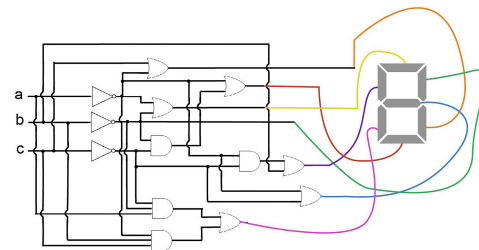

Figure 4: Settings of the riddle.

Figure 5: Riddle on logic gates.

Representation. This is the most attractive part of the tool, one that users will want to take in hand quickly. During the creation of the tool this part was the focus of the design. The aim was to get the designer motivated to use this tool rather than a sheet of paper. Rolland Viau's works (Viau, 1994), showed that motivation is necessary to persevere and to reach one's goal, that's why this tool put the emphasis on that matter through its practical and ergonomic aspects. The fact that the tool is accessible online at any time on any device, shareable and recordable will provide a significant advantage for users. They will be able to print only the elements useful for them.

- To facilitate the understanding that each riddle unlocks a new step, one could add a padlock icon opened at the end of a riddle on the line between the last step of the riddle in question and the next step. When hovering or clicking on this padlock, the detail of the unlocked object would be displayed.

- The user may want to consult the constraints quickly from the "Representation" part, an option to display the list of these constraints could be

useful (mainly on the computer and tablet version but less convenient on the mobile version).

- From the moment the user deletes a clue in the SEGAM model, he should have the possibility to reorder clues numbers. If he chooses to do so, then he could do it manually: choose which clue takes the number of another deleted or automatic: all numbers are shifted to compensate for missing numbers.

- Then, to facilitate the management of items in the SEGAM model, it would be interesting to be able to drag and drop clues from one step to another or to reorder the riddles by dragging a line and place it elsewhere.

- Finally, to facilitate the management of groups, it would be practical to be able to duplicate riddles or clues and thus manage the different parameters from one team to another. Knowing that all changes made within the representation with the SEGAM model would be reflected in the form.

Operation

- It would be interesting for new users to have access to an optional tutorial to briefly explain the functions of the tool.

- Some fields of the form may not have the same meaning for different users, so it would be useful for them to have an example of the form filled with a real project to be inspired and understand what is expected.

- In the same spirit, it might be interesting to have an explanatory bubble next to each field for a better understanding of the criteria.

Extension

- The tool can be used for puzzle games without educational purpose, some sections of the form will be no longer essential in this case.

- It may be interesting to add a menu with improvements planned in future versions of the tool, as well as a place for users to make suggestions for enhancement. The version of the tool would thus be displayed and would make it possible to realize if the tool has benefited from improvements since the last use.

- The goal is to give a maximum of elements so that the designers can take in hand riddles activities. For example regarding the escape game type, it would be useful to add advice, tips and tricks to the "Help" category. For instance with elements concerning the introduction of the game to the public like security advice classically stated, or useful elements for the final debriefing. Indeed,

debriefing is essential (Lederman, 1992; Crookall, 2010) because the teacher will come back on each riddle met during the activity and explain the course notions and expected objectives. Rewinding each riddle will allow people who have not solved this riddle (as they were solving another one in parallel for example) to return to the course notions that he could not address and get feedback on the notions seen by those who solved them. Thus the debriefing will make them aware of their learning, they will realize as well that they do not come only to "play" but also to review several notions of course and their detail.

Following these tests, the most relevant changes to help designers create their activity will be integrated in the next version of the tool, the others will be added later. For now, a tester wanted to keep the prototype to start a new project. Then, an instructional designer heard about the project. She would like to have quick access to this tool to test if her previous Escape Games fit in the tool and to help her designing the next ones. These first returns seem to confirm the important need of this type of tool and will allow to develop it according to feedback from the user community.

4 CONCLUSION

Given the first tests, this tool seems to facilitate the design of SEG for teachers, being more guided to address all the elements essential to the creation of this type of activity. This tool will evolve with time and user feedback, especially those mentioned above in the "Tests and feedback" section. Improvements are already planned: the third version of the tool will ask to be authenticated on the site thus allowing to save the project. Designers will be able to work on it in several times. It is planned to include an automatic backup to prevent unexpected data loss. Thanks to a database, each user will be able to manage several projects, to share them with other people, in public or private mode, giving the rights of modification or not. Another function will be the ability to archive a completed project: it will be saved separately, and available read-only. People with access could then find it if necessary without cluttering their list of projects in progress. Finally, users will have the option to delete or duplicate a project if they want to create a variant. Other more technical improvements are planned to improve ergonomics and to consult, create, modify or delete elements even more quickly with greater ease than before, especially thanks to the SEGAM model. To facilitate the organization of the project, it is also planned to select the parts of the form that you want

to export in pdf: for example only riddles and clues, or the list of clues, the place of their hiding place as well as associated codes for better management of the elements on site during the activity. These first elements were inspired by the different SEG realized in various contexts as well as some websites helping to design escape games (AcadémieDeParis, 2018; S'CAPE, 2017; lelivrescolaire, 2018; Quesne, 2017). The SEGAM model was used to build the structure, but many other elements were written on separate sheets and were useful during the design or implementation of our SEG. This tool makes it possible to centralize all the data concerning the escape game, to be accessible on mobiles, tablets and computers, by several people and the content can be updated regularly and easily. The next step is to spread it widely to help as many people as possible create serious puzzle games and get their feedback to make it evolve and meet the needs of as many users as possible. Then, based on the escape games that were designed with the tool, an analysis will be made thanks to the collection of user traces (students and teachers). This analysis will help to classify the SEG and to determine what type of SEG to use based on: educational objectives, the type of activity (discovery, learning or evaluation) or the type of skill (soft or hard). The results of this analysis will also allow to classify the riddles (for example, based on intrinsic or extrinsic metaphor (Fabricatore, 2000)). Thus, it would be interesting that the tool, through these elements, guides users to create riddles according to their needs by proposing similar generic elements.

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