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Tools and Methods for Efficiently Designing Serious Games

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Abstract: Serious games are pedagogical multimedia products made to help learners develop specific skills. Their use has proven to be promising in many domains, but is at present restricted by the time consuming and costly nature of the developing process. When developing Serious Games (SGs) for academic purposes, not only is there a budgetary challenge, but there is also the challenge of integrating enough educational value without sacrificing the fun characteristics. In this article, we detail the designing process of a SG and enumerate the various actors who have to collaborate: project manager, cognitive specialist, domain experts, storyboard writer, artistic director, pedagogical expert, programmers… To help them work together and communicate in an efficient way, we first propose a step by step engineering method that helps the actors collaborate in an efficient and structured way. Each member of the designing team is assigned a set of tasks. Then, we propose authoring tools that can be used to carry out these tasks. They offer the possibility of simultaneously viewing various dimensions of the SG scenario: target knowledge, storyline, learning scenario, fun characteristics… When the authors connect to the platform, each of them is provided with a customized selection of dimensions presented with more or less detail. When interacting with one dimension, the other dimensions react and modify themselves automatically in a synchronized manner. In particular, we present a number of e-learning tools, that have been adapted for SG design and that allow us to specify the target skills that have to be leaned and build the pedagogical learning scenario. The SG authors will also have access to sample SGs and resources to provide them with inspiration for using fun characteristics to captivate the learners and carry them through the learning process. In response to the need felt by many SG authors to store and share their experience, we present a number of tools to help the authors store, find and integrate reusable software components into their SGs.

Keywords: Serious Games, education, engineering method, e-learning, authoring tools

1. Background

1.1 Serious Games for learning professional skills

Nowadays, SGs are used in various domains such as training (army), education, advertising, communication (Michaud 2008) (Alvarez and Rampnoux 2007) (Prensky 2004)… In this article, we will focus on SGs designed to teach professional skills for which their use seems particularly adapted. The French Ministry of education defines a professional skill as set of correct attitudes and theoretical knowledge with the capacity of using it in various situations (MEN 2006). In order to have a more functional definition we will use the following: “an organized and coherent set of knowledge and behavior, applicable to a specific context”.

SGs have the advantage of offering virtual environments, ideal for simulating different situations and contexts in which the learners will have to develop their professional skills (De Freitas and Neumann 2009). This is a huge benefit when it is impossible or very difficult to do real scale reproduction of these environments for cost, time and security reasons. This is the case for “Pulse ! “[1] and “Interactive Trauma-

[1]. 2007, http://www.interaction-healthcare.com

Trainer"[2]: two SGs used to teach technical medical emergency procedures. For the same reasons, SGs are also used to learn the mechanisms of financial trades ("*Seer Bat*"[3]) or how to drive a train ("*Rail Simulator*"[4]).

But SGs are not just simple simulators. They also have the power to immerge learners into a world where they have to invest themselves intellectually and mentally to progress, face challenges or accomplish quests. Thanks to these mechanisms, the learners find themselves in the same situations they will have to deal with in their future jobs. All through the game, their avatar is faced with various professional skills they need to master to move on with the story and reach the final goal. In that sense, the SG gives them a global and structured view of their future profession. This is the case for "Starbank"[5], used to teach the different banking technique and "*The adventures of Casey Warren*"[6] that teaches best practices for data protection.

SGs also give the possibility of involving the learners by using interactivities and game dimensions such as competition, luck, role-playing or rewards. At the INSA engineering school in Lyon (France), we use SGs to replace the traditional classes and training sessions to learn maintenances skills, flow managements, stock management, problem solving methods, Lean management…[7] SGs can be designed as supportive tools for teachers. They can help them out by doing most of the tedious and repetitive activities. This gives the teachers enough time to assist and guide the learners.

Moreover, when training adult employees, SGs can prove themselves to be better than traditional techniques. This can be explained by the fact that adults have a hard time "coming back to school". It is also difficult for them to accept criticism coming from the tutors often younger and not as experienced. SGs provide an original and less academic alternative. Besides, SGs can be adapted so that all comments and results are given by the computer system and not by the tutor. But these comments can, of course, be written before hand by the tutors. This is the case in the SG "*Laboratorium of epidemiology"* (Gonçalves *& al.* 2009) where the messages sent by the doctors in the game are, in fact, written by real professors.

Finally, SGs offer the technical means necessary to follow the learning process and evaluate the learners automatically or semi-automatically. This is very important, especially when teaching in companies or schools. Like the SG "*Mission to sell*"[8], employers and teachers feel the need to certify the pedagogical skills learned by giving the learners a special certificate.

1.2 Costly and risky investments

The counterpart of SGs is most certainly their high cost estimated between 10 and 300 thousand dollars (Aldrich 2009). The cost depends on the complexity of the game play, the level of interactions and the time spent to design the educational model. For example, the SGs, produced at the LIESP research lab[9], cost about 15000 dollars per learning hour. Most of the budget goes into designing the educational model. Other SGs, like America's Army[10], that offer 3D graphics and allow online massive gaming cost more than 30 million dollars.

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2. 2009, http://en.allexperts.com/e/i/in/interactive_trauma_trainer.htm

3. 2005, http://www.pixelearning.com

4. 2007, http://www.eagames.co.uk

5. 2009, http://recrutement.bnpparibas.com

6. 2009, http://www.qoveo.com/espace_demo2

7. 2010, http://liesp.insa-lyon.fr/nosSeriousGames

8. www.elearning-cegos.fr

9. http://liesp.insa-lyon.fr

10. http://www.wired.com/gamelife/2009/12/americas-army-budget

The cost is all the more important knowing that the market span of SGs, due to their specific educational goals, are often very limited, thereby reducing the potential profits. Moreover, a "good" SG has to be fun and provide a significant educational gain. This symbiosis is not easy to acquire. Wrapping up the educational scenario with fun characteristics is clearly not enough. The two dimensions have to be designed so that they are tightly woven together (Szilas and Bernasconi 2007). Furthermore, when in a scholar context, SGs thought to be "too fun" have a hard time being accepted by the teachers as instructional media. All the fun characteristics must account for a part of the pedagogical strategy. If the SG is not fun enough or if the concept of the SG is not explained correctly to the learners, its use might be worse than a traditional class. Children, who are not mature enough to see knowledge as being useful, will have a tendency to be disappointed if they are expecting a game (Ben Sawyer's talk at SG expo France, 2008). On the other hand, as pointed out by a professor that teaches mathematics with SGs at Kaplan University[11] (USA), adults can find the use of games futile or feel that they are wasting their time if the use of such games is not explained.

1.3 Identifying the needs of the authors

SGs are new concepts of their own. Their pedagogical goals are similar to e-learning and yet, they use video game techniques to captivate the learners. To obtain such a mixture, many actors with different skills have to collaborate. The designing process starts with the *client* who specifies his needs and constraints. The *project manager* identifies the different tasks and distributes them to the various members of the team. If the targeted skills are not yet clearly modeled and identified, which is often the case; this will have to be done by a *cognitive specialist*. Like for any e-learning application, we then need a *pedagogical expert* to identify and organize these skills and formulate the pedagogical objectives of the SG. The SG scenario has to be designed simultaneously by two different actors: the *storyboard writer* structures the "pedagogical scenario" and matches it up with a "fun scenario" with the help and advice of the *artistic director*. The "fun scenario" is composed of the different amusing and attractive characteristics used in the SG. For example, if the designers decide to use a virtual world and a role play to captivate the learner, the amusing scenario will be composed of the chapters of the story, the characters involved, the virtual world… If, on the other hand, they choose to use a board game like for the SG "*Get the glass*"[12], the amusing scenario will be composed of the board, a set of rules and a collection of different exercises or hint cards that will be randomly chosen by the learners. The rest of the designing phase is similar to the creation of a video game. The *storyboard writer* and the *artistic director* need to describe all the visual and functional aspects that will then be sent to the subcontractors (*graphic designer, sound manager, actors*…) and the *programmers*.

Practice has shown that it is very difficult getting all these actors to collaborate and communicate in an efficient way. This is mostly due to the fact that they come from very different domains and have various objectives and tasks. Their collaboration is also hampered by the fact that they use unadapted tools. Indeed, there can either use e-learning tools to make pedagogical scenarios (Reload LD[13]) or authoring tools for making video games (Torrente *& al.* 2010) but there are no software system to bridge the gap (Marfisi-Schottman *& al.* 2009).

Like in any industrial organization, the companies and the labs that produce SGs feel the need to capitalize and share their experience. This was also the case for our research team who has helps design and produce SGs for almost fifteen years in collaboration with companies such as SEB, Thalès, CNES, HP, CALOR, COGIX… To answer this need, the production team decided to start collecting software components that could be used in different SGs (Sghaier & al. 2007).

We have shown that the use of SGs is very valuable for teaching professional skills. Yet, their complex and multi-actor designing process is far from being efficient, resulting in costly and risky investments. To solve this problem we first detail an engineering method to help the collaboration of the various actors

[11]. http://www.ramshillfarm.com/Math/GamesHigherEd/PlayingGamesPaper.pdf

[12]. http://www.gettheglass.com

[13]. http://www.reload.ac.uk/ldeditor.html

involved in the SG designing process. We then propose a set of tools adapted to their specific needs. Some of these are largely inspired of tools used by e-learning and video game companies.

2. Step by step engineering process for Serious Games

To speed up the conception process, we propose to guide the actors through the 7 steps presented in Figure 1, without, however obliging them to do them in order. This method is quite similar to Paquette's MISA method (Paquette *& al.* 1999) for designing learning systems. Still, we preferred to choose a lighter protocol: only a few of the SG parts have to fit specific standard formats. Moreover, we added several specific steps for searching reusable software components and validating the pedagogical conception.

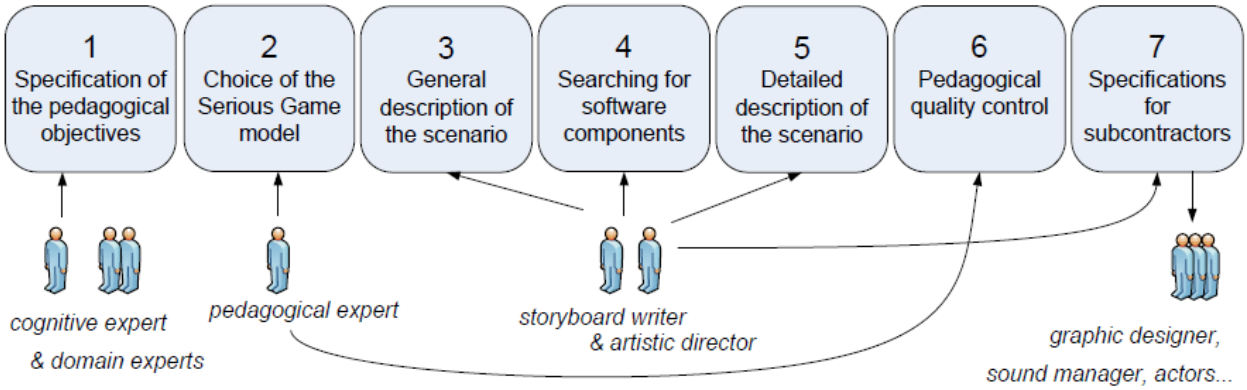

Figure 1: the 7 steps for designing SGs

2.1 Specification of the pedagogical objectives

Our SGs are used to teach professional skills. These skills can be decomposed into pieces of knowledge and behavior. The first step of the conception phase consists in extracting the domain-specific knowledge that is to be learned by the students. To do this, the *cognitive expert* works with several *domain experts* to extract and formalize the knowledge and behavior relevant to the domain. To help extract these elements, the *cognitive specialist* can use knowledge management tools and methods such as MASK (Benmahamed *& al.* 2005). The *pedagogical expert* then identifies and organizes the most important skills and defines the pedagogical objectives of the SG.

2.2 Choice of the Serious Game model

Before creating the scenario, we added a step so that the *pedagogical expert* can choose a predefined model for the SG. We currently offer the possibility of using different types: board game, investigation game, puzzle and adventure game. The choice of the *pedagogical expert* will adapt the tools and the different help modules offered when designing the fun scenario.

2.3 General description of the scenario and virtual environment

The *storyboard writer* and the *artistic director* then need to work together to structure the pedagogical scenario and match it up with a fun scenario. They mainly have to describe the elements of the virtual environment such as the storyline, the characters and the different places where the action will take place. To assist them, we propose a multi-view tool that enables the actors to design the scenario from different angles: pedagogical and fun scenario, story characters, places, professional skills, dialogues… These tools will be presented in more detail in part 3.

2.4 Searching for reusable software components

As explained earlier (cf. 1.3), our production team felt the need to collect a number of software components that could be reused in different SGs. This is the moment were the designers can search the database to see if any of these components suit their needs. Indeed, it is much more efficient to look for reusable components before they design all the elements from scratch.

2.5 Detailed description of the scenario
Once the software components that can be reused are integrated into the scenario, the *storyboard writer* and the *artistic director* still have to describe the missing parts. Among other things, they will have to illustrate each scene with all the details and interactions they want the programmers to integrate to the SG.

2.6 Pedagogical quality control
To minimize the testing phases, we set up a pre-evaluation of the SG before it is actually produced. A first set of tests can be run on the SG scenario graph to make sure there are no dead-end paths and that all paths insure that the learners acquire the main pedagogical objectives. For a more thorough testing, we can model virtual players that will act in accordance to their level of knowledge and their specific behavioral profile (curious, prudent, hasty, confident…) (George *& al.* 2005) (Manin *& al.* 2006). For the time being, this method exists only for board game type SGs that have a very formalized and simple structure, but it should be applicable to other types. The objective of these simulations is to statistically evaluate the SG in terms of pedagogical gain. With this system, we should be more efficient then when testing is only done on real people at the end of the production, which usually results in going through the production chain again.

6.7 Precise specifications for subcontractors
Before moving on to the production phase, the *artistic director* has to fill in the specifications for each subcontractor (*graphic designer, sound manager, actors*…). To help him/her out, we have collected a set of communication charters to maximize the chances of having clear and precise specifications for the various specialists.

3. Designing tools
In this part, we propose a set of tools to help the actors cooperate in an efficient way. These actors are not computer scientists and therefore require simple and easy-to use tools. This is why we present them with an ergonomic interface allowing drag and drop interactions. The interface is composed of interchangeable, movable and adaptable widgets[14]. The idea is to have one widget for each dimension of the SG. This allows the actors to design the dimensions they have the competency to work on (skills, scenario, game play…) while interacting with the other dimensions. In other words, the widgets can be used to design items or as window palettes: their items can be dragged and dropped into other widgets. So as to offer maximum possibility, we decided to extend the interface to 2 screens although it can still be used on one. Here are the different widgets of our interface:

3.1 Document widget
All through the designing phase, the authors have to produce a certain number of mockup models and documents that will later be passed on to the *programmers* so they can work on the production phase. The most important of these documents are:

- The project specifications
- The list of professional skills that must be taught with the SG
- The graph for the pedagogical scenario
- The graph for the fun scenario
- The detailed description of each scene, characters and places of the virtual world
- Booklet and use manual for the end users (clients, tutors, learners)

These standardized items are also used as clear means of communication between the different actors of the designing team. The completion of these documents is a way of keeping track of the work left to be done. We therefore propose the use of a *Document widget*, available at all times that will give access to these documents. Each of them will be shown with a progress bar giving an idea of the work left to be done.

3.2 Professional skills widget

[14] Like in iGoogle for example, www.google.com/ig

This widget is used by the *pedagogical expert* to fill in the different professional skills (Q_i) that have to be taught with the SG. Each skill must first be decomposed into pieces of knowledge (K_i) and behavior (C_i). By "behavior", we mean cognitive, affective or social abilities that the learners must acquire. In this sense, our definition is quite similar to Lasnier's (2000).
To validate a skill, the learner has to acquire at least the level marked for each piece of knowledge and prove this good behavior a certain number of times. It can happen that 2 skills require the same piece of knowledge. In this case the global value to validate the SG will be the highest of the local values. In Figure 2, for example, val (K1) = MAX{40; 70} = 70.
The list of knowledge and behavior elements corresponds to the pedagogical objectives to finish the SG. Later on, these items will be attached to the pedagogical scenario by the *storyboard writer*. Once the learners have finished the SG successfully, a record of their professional skills can be kept in an HR-XML[15] electronic profession card for example.

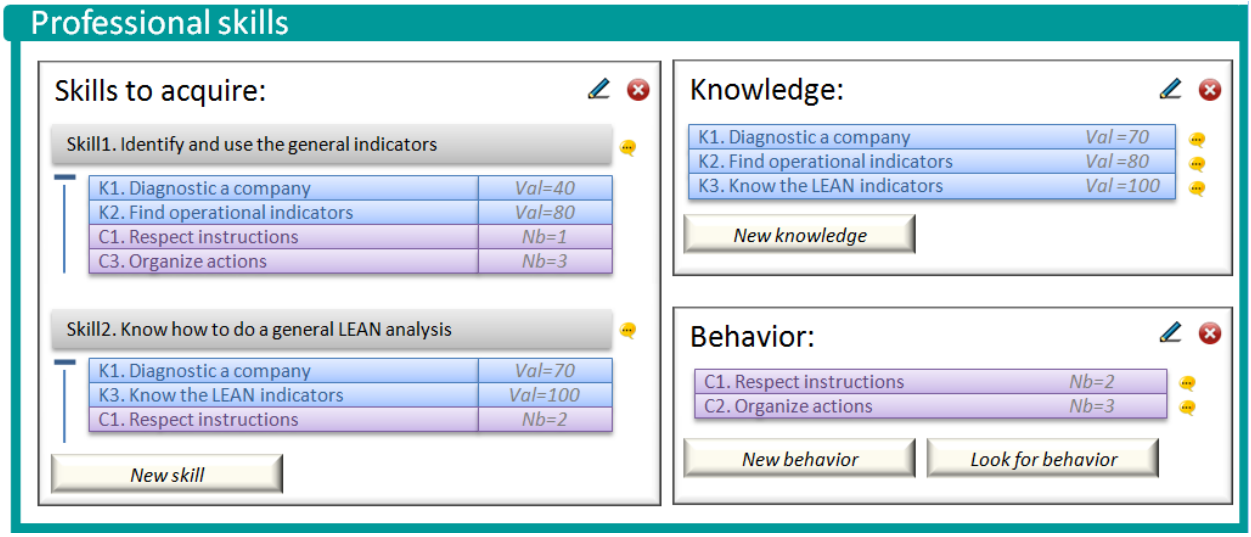

Figure 2: Professional skills widget in the « edition » mode

3.3 Component widget

This widget, shown in Figure 3, can be used at all times to search for software components in the database. These components can either be used to integrate the fun scenario or simply tried out to give the authors new ideas.
To help the authors find software components that meet their requirements, we needed to express the characteristics of each component and developed a system to do simple research on these descriptions. The software components are described with an extension of LOM (Learning Object Methadata 2002) that we developed specifically for SGs (Marfisi-Schottman 2010). The extension adds extra classifications to describe the nature of the components, the educational objectives, the reusability of the components, the game motivations…This extension of LOM suits a large variety of SG components. It was developed within the « Learning Game Factory »[16] project to describe the reusable SG software components shared by eight heterogynous corporations (video game companies, e-learning companies, research labs, institutes…). We also developed a LomPAD-SG[17] editor in order to help filling in these meta-descriptions.
The authors can search the database by using keywords or by doing a more advanced and refined search. The matching components are represented by a record card containing a picture, general information (name, type, component supplier, setting and adaptation properties…), statistics on its use and comments posted by users (clients, authors, tutors, learners).

[15]. http://ns.hr-xml.org/2_5/HR-XML-2_5/SEP/Resume.html

[16]. www.learning-games-factory.com

[17]. http://liesp.insa-lyon.fr/LOM-SG

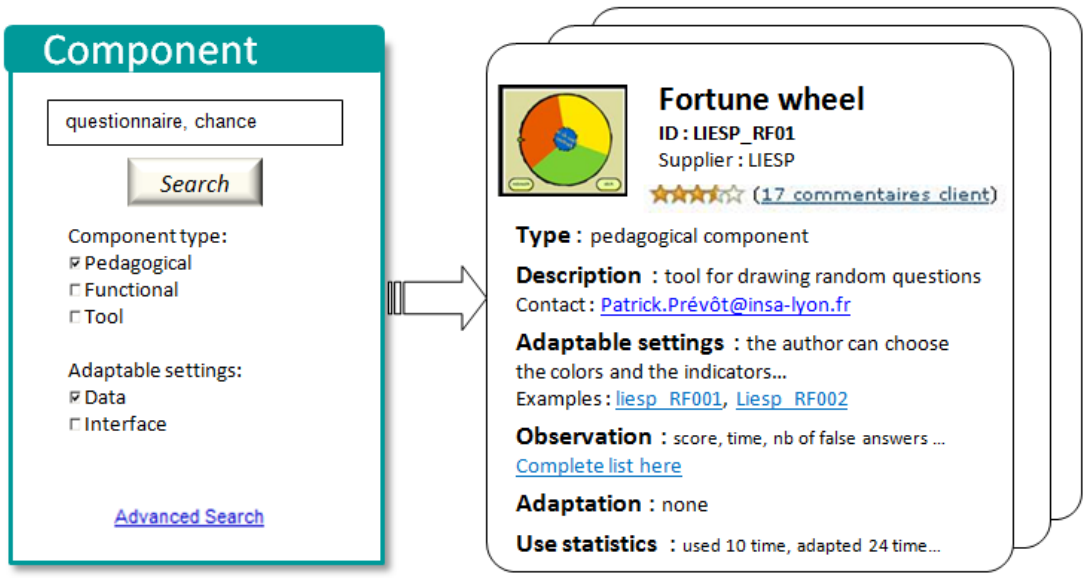

Figure 3: Component widget research tool

3.4 Resource widget

With the same reasoning as for the software components, SG authors have found it useful to collect and reuse graphical, sound and pedagogical resources. These can be directly added to the pedagogical or fun scenario.

3.5 Character widget

This widget is mostly used by the *artistic director* to specify the physical and emotional characteristics of the different characters in the story, including the learner's avatar. The widget also offers the possibility to view all the dialogues of the character to make sure there are no incoherencies.

3.6 Place widget

This widget is used by the *artistic director* to create the different scenes and places in the virtual environment. For example, if he has chosen to captivate the learner with a storyline, he will have to describe the various places where the story will take place such as castle, a research lab or a bedroom for example. The places are usually described several images or sketches. The place widget also gives the possibility to add a specific music or a map to the places. These places will then be used to complete the fun scenario and specify the various screens of the SG.

3.7 Scenario widget

This widget is ones of the most important because it represents the global structure of the SG. At the beginning, it is only composed of the pedagogical scenario defined by the *storyboard writer*. This pedagogical scenario needs to be modeled with a standard format so that it can later be automatically executed. The widely spread IMS-LD model offers the advantage of providing a set of "players" such as Reload LD Player[18] or Sled[19]. Another advantage to this model is that it allows us to share and compare our SG scenarios with e-learning companies in an efficient way. However, the concepts used in IMS-LD modeling don't seem to fit the needs of our SG authors, especially when they are novices. For this reason, we propose a model better suited to the conception needs of SG authors. This model provides for descriptions at four different levels:

- *Interactions: actions* between learners, tutor and computer (talk, click, observe…)
- *Activities*: a sequence of interactions with a common goal such as doing an exercise, looking at a video, answering questions…

[18]. http://www.reload.ac.uk/ldeditor.html

[19]. http://sled.open.ac.uk

- *Sessions*: a set of activities executed in parallel by the tutor and the learners helping the learners to acquire some specific knowledge or behavior.
- *Modules:* all the sessions required to learn all the knowledge and behavior relevant to a given professional skill.

Our scenario widget therefore offers these 4 levels to model the pedagogical scenario. The interactions are modeled with a CTT model (Concurent Tast Tree) (*Paternò 1999*). Before the execution phase, the scenario is transferred into IMS-LD format by transforming the activities into “role-parts” and sessions into “acts”.

Once the pedagogical scenario is more or less detailed, the fun scenario can be added to the graph. Usually, the pedagogical modules and sessions are structured by the links of the fun scenario. Little by little, the scenario completes it-self with various elements coming from the others widgets: professional skills, characters, places, components, resources… On figure 4, you can see that a pedagogical multimedia object (OPM1) (found in the resources) is links to the module 2 of the pedagogical scenario. The professional skills (Q1 and Q2) and pieces of behavior (C1…n) taught in each module can also be seen on the scenario. In addition, the characters and places have been dragged onto the fun scenario. Once the authors have finished describing the upper level (modules) with more or less detail, they can start describing the other levels and creating the different screens for the chapters of the story.

This widget also integrates a special mechanism to help the authors finish the details of their scenario. Indeed, the elements that are defined in the widgets but that are not linked to the central scenario are slightly highlighted. This helps the authors spot the incoherencies rapidly.

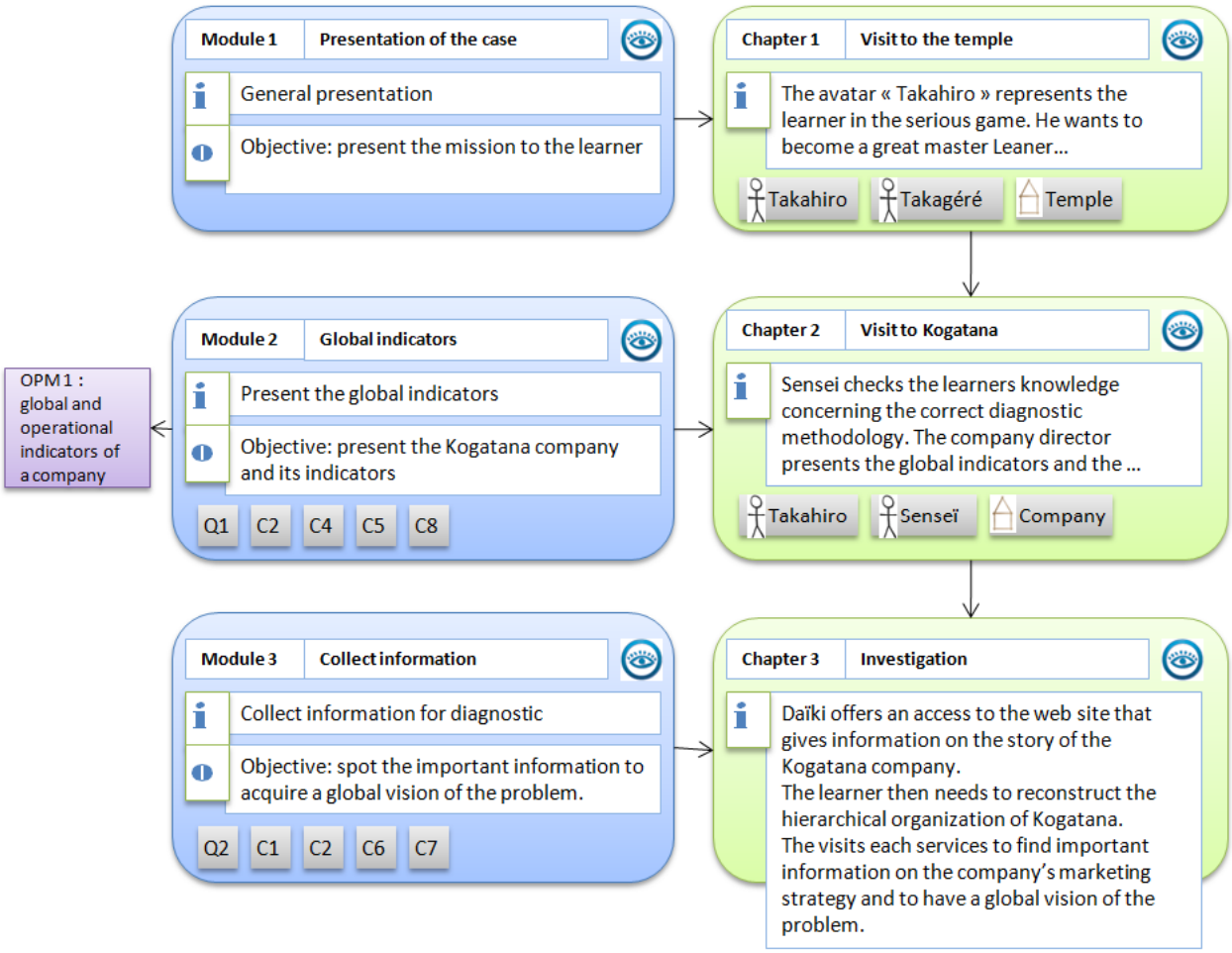

Figure 4: Scenario widget

3.8 Screen widget:

This widget is used by the *storyboard writer and artistic director* to design the different scenes of the SG as they will be seen by the learners and the tutors. The widget offers the all the necessary tools to create a mock-up model of an interface, add pictures, identify the clickable objects, enter the dialogues for each character and add comments for the programmers. The screens created this way will then have to be linked to the global SG scenario.

The members of the conception team can have access to all of the widgets described above. However, the widgets will not be accessible at the same time or for everyone. The idea is to have a dynamically reconfigurable working environment adapted to a specific context: role of the author, current step of the project and progression of the other authors. The widgets can also be reconfigured and adapted. The authors can, for example, open all the widgets they want, and even several widgets of the same type. When an item is being manipulated in one widget, the other widgets are automatically put up to date.

4. Conclusion and perspectives

The work presented in this article aims at defining tools and methods to help design SGs. The idea is to lighten the authors' workload and give them the possibility of exploring pedagogical innovations that feature fun characteristics.

Our main contributions are a seven-step method for designing SGs showing the different actors and tasks to be accomplished and a set of multi-view tools to support these tasks. These tools were designed after analyzing the needs of SG designers. They will be tested with groups of engineering students from the INSA who, as part of an educational project, design and develop SGs ordered by real companies. By comparing the efficiency of these students with that of groups from preceding years, we hope to find an improvement.

In the near future, we also aspire to improve our tools so as to help the authors integrate and adapt the software components and the resources to their SGs. We have already collected a set of examples and best practice rules for using each component at to its fullest but we are convinced that there are still quite a few rules that could be found. For example, we hope to formulate a rule to coordinate the use of different learning styles.

The field of SGs is still very far from being fully explored, and we have tried, with our research, to open new perspectives and broaden the application domains of SGs.

References

Aldrich C. (2009) The Complete Guide to Simulations and Serious Games, Pfeiffer, USA.

Alvarez J. and Rampnoux O. (2007) "Serious Game: Just a question of posture?" In Proceedings of Artificial & Ambient Intelligence, AISB'07, Newcastle, April 2007, UK, pp 420- 423.

Benmahamed D., Ermine J-L. and Tchounikine P. (2005) "From MASK Knowledge Management Methodology to Learning Activities Described with IMS – LD", Wissensmanagement, pp 165-175.

De Freitas, S. and Neumann, T. (2009) "The use of 'exploratory learning' for supporting immersive learning in virtual environments" *Computers and Education Journal*, 52(2), pp 343-352.

George S., Titon D. and Prévôt P. (2005) « Simulateur de comportements d'apprenants dans le cadre de jeux d'entreprise", In proceedings of Environnements Informatiques pour l'Apprentissage Humain EIAH05, Montpellier, 25-27 mai 2005, France, pp 389-394.

Gonçalves C., Ney M., Balacheff N. and Bosson J-L. (2009) "Student's Problem Appropriation in an Epidemiology Game" In proceedings of the *3rd European Conference on Games Based Learning, of ECGBL09*, Graz, 12-13 October 2009, Austria, pp 135-144.

Lasnier, F. (2000) Réussir la formation par compétences. Guérin, Montréal.

LOM (2002) Standard for Learning Object Metadata, IEEE 1484.12.1.

Manin N., George S. and Prévôt P. (2006) ''Virtual Learners Behaviours in Educational Business Games" *Computer Science journal, Innovative Approaches for Learning and Knowledge Sharing*, vol. 4227, pp 287-301.

Marfisi-Schottman I., Sghaier A., George S., Tarpin-Bernard F. and Prévôt P. (2009) "Towards Industrialized Conception and Production of Serious Games" In proceedings of the *ICTE International Conference on Technology and Education*, Paris, 25-27 June, France, pp 1016-1020.

Marfisi-Schottman I. (2010) “Environnement informatique pour la conception, la production et le suivi de Serious Games” In proceedings of *Rencontre Jeunes Chercheurs – Environnements Informatiques pour l'Apprentissage Humain, RCJ-EIAH10*, Lyon, 6-7 Mai 2010, France, pp 53-58.
MEN, French Ministry of National Education. (2006) “Le socle commun des connaissances et des compétences ”, décret du 11 juillet, 27 p.
Michaud L. (2008) *Serious Games*, report of the IDATE, consulting and research, M83708, June.
Paquette G., Aubin C., and Crevier, F. (1999). “MISA: A knowledge-based method for the engineering of learning systems”. Journal of *Courseware Engineering*, August.
Paternò F. (1999) *Model Based Design and Evaluation of Interactive Application*. Springer Verlag.
Prensky (2004) *Digital Game-Based Learning,* McGraw-Hill, August.
Sghaier A., Prévôt P. and Tranpin-Bernard F. (2007) "Towards a Generic Environment for the Design of Serious Games" In proceedings of *Learning with Games 2007*, Sophia-Antipolis, 24-26 September, France, pp 295-300.
Szilas N. and Bernasconi L. (2007) “Double blended learning” In proceedings of 8th International Conference on Information Technology Based Higher Education and Training, ITHET2007, Kumamoto, July, Japan.
Torrente J., del Blanco A., Marchiori E., Moreno-Ger P. and Fernández-Manjón B. (2010) “<e-Adventure>: Introducing Educational Games in the Learning Process” In proceedings of *IEEE EDUCON 2010 (e-Madrid special edition)*, Madrid, 14-16 April, Spain.