Supporting Crisis Training with a Mobile Game System

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Abstract. Crisis training is highly complex and it requires multiple approaches. Games have a high potential in this context because they might support players in exploring different situations and experience different crisis scenarios. This paper proposes a mobile game system for crisis training. The system aims to promote soft skills and basic procedures learning. The system is composed by (i) a website that allows to set up the game and review game results and (ii) a mobile game. The set up supports the tailoring of games that better fit the specific learning needs of the players. The actual play promotes gaining of experience. The final review is intended to promote reflection on the gained experience, mirroring debriefing sessions that are common in crisis situations. Results from the initial evaluation show that the game and the post-game reflection are useful to train soft skills and to improve behavior.

Keywords: Serious Games, Crisis Management, Mobile Games, Soft Skills.

1 Introduction

Protecting the population during large events, emergencies, and disasters, is a complex effort that requires sophisticated training approaches. Training materials, coaching, simulated emergencies to recreate realistic working experiences, and reflective learning by debriefings are the most used methods to train emergency workers to manage emergencies. Recently, alternative learning approaches such as Serious Games have been introduced to teach workers different skills in an engaging way [1].

Our latest researches in this field are aimed at discovering in which way mobile games can be used to promote skills related to crisis management (CM). In particular we are interested in how to promote soft skills through games. The importance to support also soft skills (e.g., communication styles during a crisis, team management and coordination, time management, stress management) is underlined by the fact that: "The key to effective crisis management lies not so much with the writing of detailed manuals (that have a low likelihood of being used) and practicing location evacuations as with structured and continuous learning processes designed to equip key managers with the capabilities, flexibility and confidence to deal with sudden and unexpected events." [2] In addition, many teamwork articles stress the importance of establishing teamwork skills - such as communication and coordination - in order to survive in uncertain and dynamic environments [3]. We suggest the usage of Serious Games to support training. Games support players in exploring a set of possibilities and playing with different solutions, fulfilling goals in a variety of unique, sometimes, unanticipated ways. The fun factor is intended to act as a motivation to play repeatedly and

M. Ma et al. (Eds.): SGDA 2013, LNCS 8101, pp. 165–177, 2013.

therefore gain different perspectives on the space of possibilities. While it might be difficult to learn hard skills for emergency management with a serious game, there is a good potential to develop soft skills [4]. In particular Mobile Games can help in creating alternative training scenarios. First of all they are a low cost way to implement situated learning (i.e., learning from experience in a *real environment*). In addition, mobile technologies enable learning to occur in a multiplicity of more informal (physical and virtual) settings [5]. Finally they allow for the exploration of the real territory emergency workers could be required to intervene. However if we look at the current state of the art of games for training in the crisis management context we find that most of them are focused on detailed procedure taught through desktop games (see Section 2). For this reason in this paper we propose a mobile game system to be used to promote soft skills learning and supporting post-game reflection. The rest of this paper is structured as follow. Section 2 proposes an overview of games for crisis training. Section 3 describes our previous work which allowed us to create the system presented in Section 4. Section 5 describes a first evaluation done in order to understand the usability and the engagement with the system while Section 6 draws some conclusions.

2 Games for Crisis Training: An Overview

Before conceiving our game design we analyzed already existing games. In particular in this section we describe 7 serious games and 2 mobile games which demonstrated to have interesting games elements linked to soft skills. For this reason we will firstly briefly describe the games while Table 1 will summarize our results.

Triage Trainer. The game tests players' speed and accuracy in carrying out Triage Sieve. In the game players must identify casualties needing immediate or urgent medical attention at the scene of a major incident. Players must deal with highly realistic casualties, which show distress and display medically accurate symptoms validated by doctors.[6]

The Red Cross Game. In "The Red Cross Game" you are in control of a Red Cross base camp and your decisions can be life saving. The game is more a simulation, made with the help of Red Cross specialists. It teaches you how to control a group of emergency workers, where you must prioritize life-demanding tasks. [7]

Emergency 2012. Emergency 2012 is a strategy game where you play an officer in charge of a crisis situation. The players need to make sure that all personnel are in the right place, doing the right thing at the right time. The players must make clever use of vehicles and personnel such as police officers and rescue dog in order to bring everything back under control after a disaster. [8]

BW4T-I. BW4T-I[9] is a game based on Blocks World For Teams (BW4T) which was a game originally made to study human-agent teamwork. This game is not linked directly to crisis management, but focus on planning and decisions that need to be taken by each individual in a team. BW4T-I starts with a negotiation phase. In this negotiation phase the team members will need to make a decision on how they are going to play the game, depending on the group and individual goals. They need to reach an outcome in ten minutes, which emulates the time pressure contained in the crisis management decision-making process. This outcome will be given to the agents that will play a simulation based on this. This approach allows the team members to

see the direct effect of their negotiation outcome, and also prevents the team members from changing their plans during the game.

On the same line *RescueSim* [10] is a multidisciplinary training software that prepares public safety and security professionals for real-life incidents in a virtual environment. In *RescueSim* allows emergency crews assess the situation and determine the best response strategy, implement it and then observe the consequences of their decisions.

Incident Commander [11] was released by BreakAway and the US Department of Justice in 2007. The game teaches incident management for multiple scenario's, including terrorist attacks, and natural disasters. Incident Commander can train up to 16 players simultaneously, with users assuming roles as either the commander or members of the operations team.

Finally, *Web-based micro-world simulation for emergency management training* [14] is a simulation system used for investigation and training experimentation of team decision making and situation awareness targeted at fire fighters.

In our research we weren't able to find mobile games used to teach crisis management aspects. For this reason we also analyzed two pervasive games. Pervasive game were chosen because they allow for exploration and interaction in the real territory, which is one of the elements considered important in crisis training.

Can you see me now? (CYSMN)[12] Can you See me now? is a chase game played online and on in the field. The online players are dropped at random locations into a virtual map of a city. The on the field players, the runners, are tracked by satellites and appear in the online game. Online players guide the runners in the real city, in order to avoid the other players. This game bridges real-life and digital world to create a mixed reality game.

Capture the flag (CTF)[13]. In this version of the popular game Capture the Flag, players from two different worlds, the virtual and the real, collaborate and compete using mobile devices, PCs, and the network. To win the game there is no room for misunderstandings during communication. By creating physical and social interaction in a pervasive environment this game is a good example of a mobile collaborative mixed system.

Table 1 summarizes our findings.

Table 1. Trained skills summary

Game	Game Genre	Trained Skills
Triage trainer	First person	On-site knowledge, procedures
Red Cross game	Strategy	Strategy management, procedures
Emergency 2012	Strategy	Strategy management
BW4T-I	Strategy	Collaboration
RESCUE SIM	Strategy	Preparedness
Incident Commander	Strategy	Procedures, roles
Disaster Hero	Various	Preparedness knowledge
Web-based microworld simulation for emergency management training	Simulation	Decision making and collaboration
Can you see me now?	Augmented reality	Real field/communication experience
Capture the flag	Augmented reality	Real field/communication experience

As you can see, the analyzed Serious Games focus on procedures more than soft skills, while the mobile games focus on soft skills and territory exploration. For this reason we decided to create a mobile game able to bridge the two aspects.

3 From Tabletop to Mobile

Before starting the design of the mobile game system we describe in Section 4 we tried different approaches. In particular we developed a tabletop version of the game, which was tested with emergency experts. To overcome its limitations (which are the same of the Serious Games described in Section 2) we designed a mobile version. Storyboards of its functioning were shown to the same experts and the design was adjusted in order to create a more comprehensive system able to address personalization and debriefing issues. In the rest of this section we describe more in detail the above mentioned process.

A First Tabletop Version: Game Dynamics
The first version of Don't Panic [17] is a cooperative board game inspired by games such as Pandemic [15] and Monopoly [16]. Each player starts the game as member of a panic control team that must work together to calm down people, preventing the biggest panic event humanity has ever seen. During the game session different potential panicking events will take place in the city represented in the board. Each player assumes a unique role within the team, with special abilities that improve the team's chances if applied wisely. In order to play the game a player gets a limited number of actions to spend on her turn. In this way the player has to think wisely how to use the actions he can do. The players have a limited time to calm down the situation, before the panic will spread and they will lose the game.

Learning Objectives of the Game. Don't Panic has multiple aims linked to soft skills teaching and learning. In fact the game wants to teach communication styles useful to manage crisis events but also foster team building. That is the main reason why the game is a collaborative one and not a competitive one. The game was conceived to push local vs. global reasoning, problem dissection and making plans dividing the board game into zones and adding unpredictable events during the game which can create contrasting reasoning and priorities. In order to achieve these goals the game uses two means: the rules and the content. First of all the game rules are studied to push the player to put into practice the "best practices" linked to soft skills for crisis management. Secondly the content of the game reflects real life information and events linked to crisis management. This kind of game can be used with different targets form the crisis management team, to the volunteers, to common people (in order to sensitize them to the crisis management problem). In order to address the different targets only the contents (from more to less detailed) and not the rules of the game have to be changed. In the rest of this section we will present in detail each element of the game design underlining its potential usefulness in the crisis management field and in particular in managing panicking events.

Evaluation. *Don't Panic* was tested with 10 Civil Protection experts belonging to different organization. In between our participants we had maxi emergencies coordinators, dog handlers, and medical emergency experts. We had a high acceptance rate of the game for volunteers' training, and its usefulness for leadership or communication management was established. On the other hand it was underlined that a low fidelity implementation of the applied procedures can be counterproductive for training purposes. For this reasons we decided to move towards a mobile game in order to provide an experience based training and thus more authentic learning.

Fig. 1. A game session

A First Mobile Design: Game Dynamics

Our main research question for this experiment was: is there a way to address crisis management characteristics, and in particular soft skills, in an environment that can allow for authentic learning through a mobile serious game? To answer this question we designed the mobile mixed reality game called MoDo which is described hereafter.

MoDo [18] is a mobile game structured to be played in teams in a physical environment through the usage of mobile devices and technology-augmented objects. Each team has to complete its mission, to evacuate the people inside a zone or a building, before the other team does. This means that the teams have a limited amount of time to complete their missions using the resources (such as augmented hammers, chains, and the like) they are provided with. After this time they automatically lose the game. The game starts with a particular situation in the zone - for example a certain amount of wounded people, panicked people, collapsed walls, and so on - and the teams have to explore the territory in order to save people. However the players are able to see what the situation in a zone is, only by being in proximity of that zone (e.g., they will see the number of panicked people in a room only if they are near that

room. At the end of the game the teams will be ranked following the time used to complete their mission and the number of people they were able to evacuate. This means that each team has to "collect" and evacuate the maximum number of people in a limited amount of time. To do so the team has to bring the "collected" people back to the entrance point of the building/zone. The social aspect of the game includes then collaboration within the same team and competition between teams. The game is conceived so that only few key points are fixed: (i) the resources usable by the teams are limited; (ii) there is a limited time to complete the missions. All the rest of the game is linked to emergence dynamics (e.g., when and in which way the players use the resources, if they communicate/coordinate or not, and so on.) All the movements and events are tracked so that they can be used in the debriefing phase.

Learning Objectives of the Game. MoDo has multiple aims linked to soft skills and best practices. The missions inside the game are conceived to push local vs. global reasoning, problem dissection and making plans as dividing the game arena into zones and adding unpredictable events during the game which can create contrasting reasoning and priorities. The content of the game reflects real life information and events linked to crisis management. As the game is played in a real environment the players have to learn to use their competences taking into account also the other players and the environment they are playing in. All the teams are given a limited amount of resources and they have to use them wisely. Resources (typically physical objects augmented with sensors) are used to interact with the territory/building in order change a potentially dangerous situation. Finally not all the members of the teams have access to the same information (i.e. we implemented asymmetric information inside the game). The MoDo game is played in a real environment so that sensible areas in the city or of a building can be used for training. The game provides the narrative context for the situation in a real environment and the possibility to create tailored content for each group at low cost. All the actions that the players are able to use within the game were discussed with experts. Also the choice of which kind of tool to augment was decided following experts interviews (see next subsection). The mixed team structure and the game rules allow for intra team communication and collaboration in order to solve a common problem. The expertise shared has then the possibility to evolve - through time and through the usage of debriefing sessions -into knowledge.

Evaluation. In order to validate the game concept before the implementation we conducted an expert evaluation with 4 crisis and emergency experts. Two of them were civil protection leaders, the other two came from the industry as sellers of emergency software and one of them in particular is a volunteer firefighter with a long experience. We used scenarios and low fidelity mock ups to discuss about the game. This expert evaluation allowed us to validate some game design aspect (such as the usage of the augmented objects) and to erase some other (like the kind of movement patterns the players have to follow in order to save the trapped persons).

They considered the whole game as a possible successful training means and the comments we got from the experts were directed towards little changes in the game dynamics while the scenario was easily accepted as realistic. In particular comments went into the direction of hints about *how to stick to real life procedures.* For example

we were explicitly asked to add in the gameplay the necessity to bring people in a common room for a triage operation. Also the importance to find a way to keep track if the augmented object were used in the right sequence was underlined. Finally, two elements were underlined during the experts' interview: the importance to personalize the training and the importance to be able to review previous performances. During our experts interview we got several hints about what could be useful to track during the current game session. The tracking can then help in structured debriefing sessions, but also to promote quick and long term reflection at the individual as well as at the group level.

4 From a Game to a System

Starting from previous considerations we decide to move from a game to a game system able to support also personalization and post-game reflection. Fig. 2 shows the process overview.

Fig. 2. Process overview

In more detail, the system consists of a website which is used for the initial configuration and the post-game reflection. For this experimentation the system is used in conjunction with the mobile game presented before but has the potential to be used with whatever game. An expert can use the website before beginning the game to configure the future game session. Fig. 3 shows the configuration page. On the web page it is possible in particular to create a dynamic map, decide which kind of object will be possible to use during the game, and if or not a briefing message will be given before the beginning of the game, stating for example how many people are trapped inside the building. This kind of configuration allows to modify the learning objective from one session to another. For example, if the main objective is territory exploration the map would be larger, if the main objective is learning how to manage multiple difficult situation, the number of people can be higher, and so on. Once the game is configured, the game session is open and the players can join the game. The kind of game they will play (i.e., it's game dynamics) is the one detailed in the second part of Section 3. Fig 4 shows two screenshots from the game.

Once the game is finished the website will present different types of statistics. In particular the statistics will show:

– Use of resources
– Movements in the territory
– Number of saved civilians vs dead civilians

This kind of information will contribute to the debriefing session which is held after the game. To maintain the engaging part of the game, each player is presented with a game score, calculated combining the number of saved civilians and the game duration. Fig. 5 and 6 show the website with the statistics of a game session. Finally Fig. 7 shows the overall structure of the system.

Fig. 3. Configuration page

5 Evaluation

The evaluation presented in this section is an initial assessment to understand usability and playability of the game before assessing learning aspects with real experts and emergency workers. The overall system was tested in three iterations, with a total of 15 people. From one iteration to the other changes to improve the system usability were implemented while no changes were done on the game dynamics. In this section we report only on the last iteration with a stable system. 5 people were asked to complete a set of tasks with the system (involving setting up a game session, play the game, do the post game reflection). Their behaviour was annotate and after the test they were asked to fill a survey (agree/disagree scale with 5 items). In addition their performances during the game were stocked into the system. For this experimentation the players were let free to play the game as many time as they wanted and they choose to play it twice. Hereafter the results of the evaluation.

Fig. 4. Two moments from the game

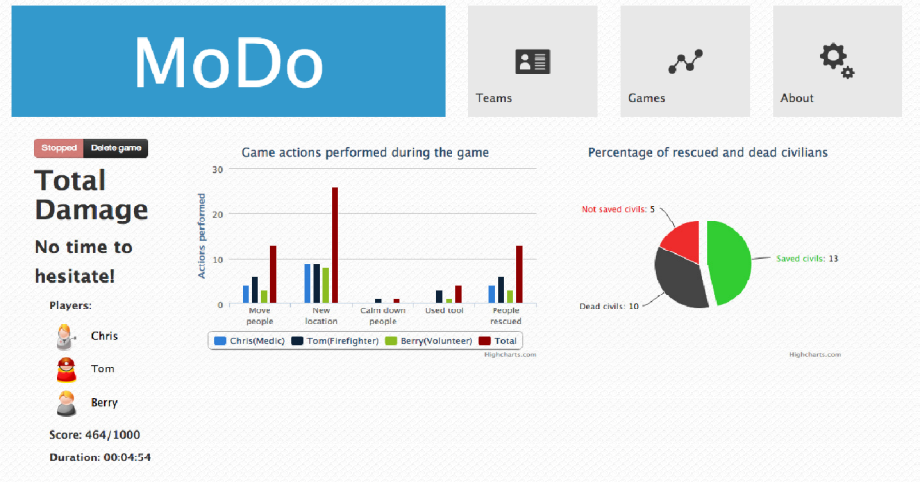

Fig. 5. Results used for debriefing session

5.1 Set up Phase

No interesting results emerged for this part, apart from a good system usability (3 players agreed while 2 strongly agreed that it was easy to use the website for the setting up phase). We believe that more interesting results will derive from an expert evaluation we are planning.

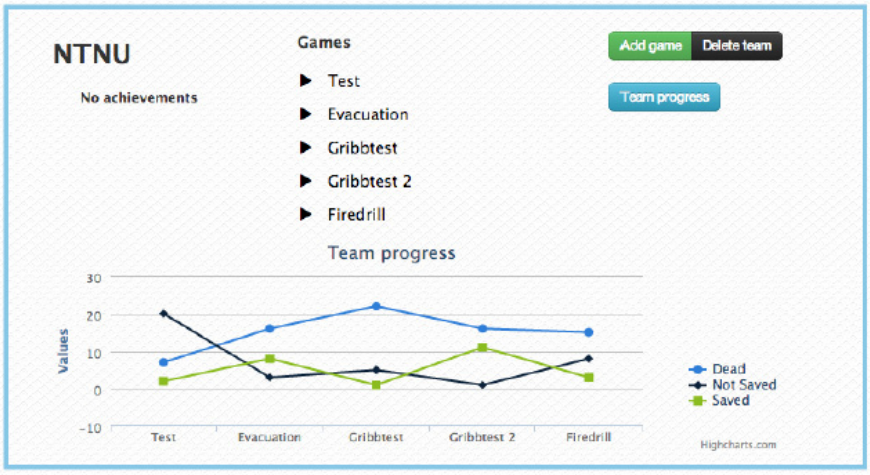

Fig. 6. Another way to show game statistics

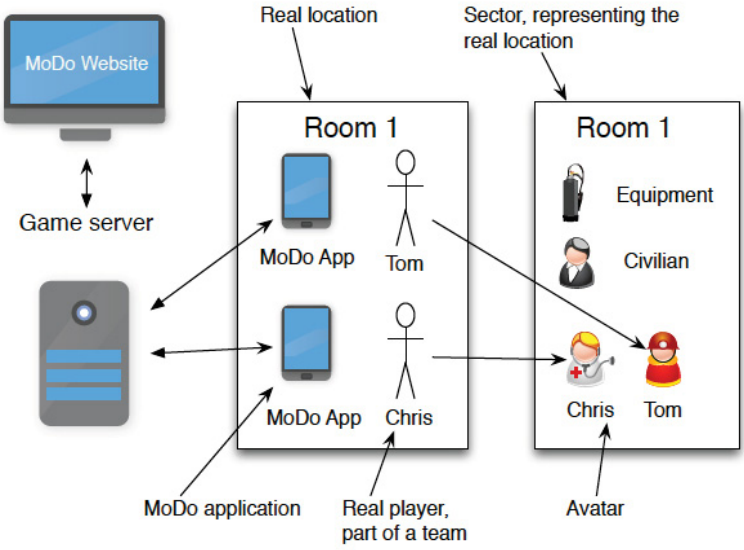

Fig. 7. Overall Structure of the system

5.2 Soft Skills Evaluation

The players discussed tactics to use during the game before, during and after the game (element observed during observation and state also in the survey). The interaction and communication between the players increased after the first round. During the first round the players discussed loosely about their tactic. One of the players said

when the game started: 'I will just go over there and take a look'. When the game started they spread out to different sectors, and after a short period of time there was total panic in the game. Players were stuck on each sector trying to calm down and heal civilians while the panic constantly increased. Their tactic was clearly not very effective, and when the game was over they had saved only one civilian. However the players were excited by the game and they immediately wanted to play another round to improve their score. They discussed their performance, and concluded that they needed a more strategic tactic to deal with the increasing panic. They had understood the concept better, and wanted to take better advantage of the different roles. They planned to move to each sector in a more structured way, and stick together so that they could be able to save more civilians.

We can then state that the game pushes the players to put into practice a strategic behaviour in order to win the game.

In the first round the players walked to move between the sectors. In the second round they were running. This is an aspect which needs more investigation it but suggests that territory exploration could be successful in the game. It's worth to note that running in the game was a physical challenge that force people to interact on different levels (physical and verbal).

Collaboration and interaction are elements required to enhance team building. The players communicated and collaborated in a constructive way. When someone was located a sector they discussed what to do and they used broadcasting messages to coordinate. In this way they managed to coordinate their movements. They also focused more on saving civilians rather than calming them down. When the game ended they had saved eleven civilians, which was a large improvement from the first round. All the participants thought the usage of roles forced them to communicate during the game.

From observation and surveys we can state that the game forced players to communicate before, during and after the game. Obviously this experimentation is not enough to confirm that team building can be achieved through the game, as team building is a process happening through time. However this is a good indicator which is worth to be explored more.

During this user's test it was clear that the users were engaged to play. 60% of the players said they were highly motivated to play, while 40% said they was very motivated. Pressure during the game was important to simulate stressfully situations, but it was also useful to provide engagement. 80% of the players stated that the game was stressful. However, this didn't affected in a negative way their enjoyment of the game.

This consideration shows that the game was able to provide the right balancing between stress and engagement.

5.3 Post-game Reflection

The website was designed to manage teams and games, but also support post game reflection. The website distinctively present the results from each game, as well as team progression. In the experimentation the players were responsible to use the

website to create, play and reflect on their result. The users were interested in their performances during the game and they used the generated results to discuss tactical improvements for the next game session. In particular game statistics promoted reflective general discussions (e.g., what was our performance? why did we move so much? how many civilians did actually die?) while players statistics promoted reflective personal thinking (i.e., I should focus more on moving people instead of healing the injured) which resulted in a new team strategy.

These results are indicators that the post-game reflection can help in improve actions through discussion about previous performances. However this is an aspect which needs to be evaluated with experts in order to assess it's real effectiveness.

6 Conclusion and Future Works

As we can see from the previous Section the mobile game system we presented has the potential to teach teaching various skills related to crisis management (in particular soft skills like collaboration, team building) and to use reflective learning to improve personal and team actions. We have seen that the game pushes the players to put into practice a strategic behaviour in order to win the game, and that the players coordinates in a constructive way. Finally, the game engaged players through its mix of virtual and real-life game environment. What is needed now is to understand what will happen to the game dynamics when are emergency workers to play the game (for example to understand if the games enjoyment distracts from the learning objectives). In addition is very important to understand if the setting phase and the post-game phase are useful for training or need improvements. For this reason in the near future we will run an experimentation involving the same experts which used the first version of the system and that discussed the mobile game storyboard. This evaluation will not only allow us to assess if the learning aspects of the game are successful in the crisis management context but also in which situation a particular interaction way (mobile vs. tabletop) is more useful in order to teach a particular set of skills.

Acknowledgments. The work is co-funded by NFR-VERDIKT 176841/SIO FABULA (http://teseolab.org). We thank all the participants, in particular the students and Gianni Della Valle, for sharing with us their knowledge of the domain.

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