

GAMIFYING LEARNING OF MARITIME STANDARD OPERATIONAL PROCEDURES

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ABSTRACT

In this paper we analyze the design decisions of a maritime chemical incident OP and SOP training game through the Octalysis gamification framework. The goal is to understand how well the learning game manages to implement the gamified features and thus increase its engagement. We argue that even though the game is still under development and the framework is not a silver bullet in analyzing the gamified content, the design decisions made for the game seem valid and thus it motivates people to train saving lives in these dangerous incidents.

INTRODUCTION

In this paper we introduce the on-going development of a maritime chemical incident search and rescue gamified learning platform GameSAR and analyze the gamification process through Octalysis framework. The learning platform is part of EU-funded ChemSAR -project which aims to *“create uniform operational plans and standard operational procedures (SOP) to save human lives in maritime HNS accident areas in a manner that the lives of the rescue crews will be protected and the impact on the environment will be minimized.”*(ChemSAR, 2018.)

Maritime sector transports great amounts of hazardous and noxious substances. If vessel carrying these substances has an accident, the resulting search and rescue operation requires its own set of procedures to counter the adverse effects caused by the cargo. Traditional training methods in crisis management include classroom learning for theoretical background, live training in physical simulations and variety of software-based methods ranging from serious games to virtual reality environments. (E.g. Heldal & Wijkmark, 2017)

All of these means are used to relay experience based information and teach skills and procedures that will minimize harm to the rescue personnel and other stakeholders on the harm's way. As noted

earlier, there are highly immersive virtual reality environments for these purposes. One of these is the RS Maritime System by VSTEP B.V. For other examples see e.g. Göbel (2016).

Environments like this are highly immersive and can be used in all levels of the training, including the training of the on the ground personnel and their hands-on procedures. Downside of these environments is their relatively high price and requirements for equipment and facilities.

On the other end of digitized teaching methods we have the serious games and gamified learning materials. Serious games and gamified materials are less immersive than virtual reality or 3D simulators, but they can be used as platform to promote case-based reasoning on situations in which subjects are exposed to a new situation with limited information and they have to start to solve the situation based on their knowledge.

In this paper we aim to test the game through the Octalysis framework. We aim to evaluate our design decisions through and validate our decisions via the framework as well as bring a new case for the framework. We describe the background and reasoning for the case, a new learning game for a search and rescue protocol, and present the methods and analysis for gamifying the learning simulation.

CHEMSAR PROJECT AND ITS GOALS

As the ChemSAR background report (Yliskylä-Peuralahti, 2017) attests, there is a lack of operational plans (OPs) and standard operational procedures (SOPs) for search and rescue (SAR) operations at sea, applicable to cases of hazardous and noxious substances (HNS) incidents in the Baltic Sea Region (BSR). The Interreg BSR project ChemSAR - Operational Plans and Procedures for Maritime Search and Rescue in HNS Incidents - combats this problem by creating operational plans and standard operational procedures for use in SAR operations where HNS are involved. To support the implementation of the SOPs and OPs, the project creates an e-learning platform with learning materials, together with a chemical databank and a gamified training tool. The learning environment

will raise awareness and emphasize the complexity and limitations of an HNS-related SAR operation at sea.

ChemSAR learning materials are supplementary to already existing SAR material, e.g. national guidelines, SAR education and training, as well as the International Aeronautical and Maritime Search and Rescue Manual of the International Maritime Organization. The target groups include rescue, environmental and maritime authorities, SAR training and maritime academies, and shipping companies and seafarers.

The complexity of the issue provides an interesting and challenging framework for learning material development and gamified training tool. ChemSAR concept highlights the need for joint procedures, coordination and cooperation between different actors within and beyond national boundaries. Due to the different kinds (differing physical and chemical properties), quantities and combinations of chemicals transported, the variety of hazards they may pose is extremely large. Within this versatile and challenging operating environment of highly skilled professionals, ChemSAR e-learning platform strives to offer a pleasant and effective learning experience.

GAMIFICATION AND SIMULATION EXERCISES

Simulation exercises for ChemSAR e-learning platform are aimed for the operational leads, thus they are conveying best practices for handling various situations during incidents involving cargo with NHS on board. In these cases the important factors are usage of time and suitability of the decisions for the ongoing situation. For this we decided that instead of full blown virtual environment much simpler decision making simulation based on the real-time clock and situational awareness was deemed to be most suitable solution.

As we didn't want the 'gameness' to be something that is glued on top of simulation, we looked for existing design guides and frameworks. As we are already familiar with gameplay design patterns we started from them. These patterns contain "commonly recurring parts of the design of a game that concern gameplay". (Björk & Holopainen, 2004) As our simulation tool is not an game for entertainment, but more like a game-like or gamified solution, the gameplay design patterns were not really helpful for us expect as a general design tool. There exists a small set of gamification patterns by Ašeriškis & Damaševičius (2014) which we found to be more helpful on the design decisions.

These patterns do not contain a way to validate if the produced system really is gamified, so for this we had to find another way. As we have not yet done extensive user testing, we had to be able to do it on by expert review. To find a tool for this review, we looked for the relevant literature and found review by Mora et al. (2015) for existing gamification design frameworks. We familiarized ourselves with these and looked for other works that had utilized the frameworks presented on the review. With this process we selected the Octalysis framework (Chou, 2015a; 2015b) and accompanying Octalysis evaluation tool (Chou, 2015c) to help us in our evaluation. Previous uses for this tool contained the work by Yfantis and Tseles (2017) in which they used Octalysis to evaluate civic platform Challenge.gov and Economou et al. (2016) who evaluated the serious games platform for learning.

Octalysis is a gamification framework which has set of eight "Core Drives", scored using a scale from 0 to 10. These are related to different aspects on eliciting motivating and engaging experience, as summarized in the following Table 1 (based on Chou, 2015b).

The analysis is based on the first level of Octalysis framework. On the deeper levels we could be analyzing things like how we are onboarding the player or how we handle the end game. But, our game is about learning in predetermined time frame so we don't have to worry about these kinds of aspect.

GAMESAR – DESIGN GOALS AND GAME DESCRIPTION

The main goal of the GameSAR is to support the other learning material produced by the project and thus support the goals of the project in educating the operational plans and standard operational procedures in HNS incidents. Thus the game is also an educational tool amongst a larger variety of tools and must be understood as such.

The objective of the GameSAR is to learn SOPs and OPs by repetitive but yet engaging manner so that the player a) can learn how to act on a maritime chemical rescue situation where a lot of information is primarily unavailable and thus improve their skills as a rescue center officer and b) is aware and understands how the rescue center works - even though they may not work there.

There are two main design goals for the game. First and foremost the game must be easy to adopt and use thus negating the possibility of digital divide. The user-base must be understood to be varied by age, gender, and gaming history and therefore only the

most common game elements as well as those most easily understood can be used in the UX design.

Table 1: Core Drivers of Octalysis (Chou, 2015b)

Epic meaning and calling	Person believes they are doing something greater than oneself or was “chosen” to take the action
Development and accomplishment	Internal drive for making progress, developing skills, achieving mastery, and eventually overcoming challenges
Empowerment of creativity and feedback	Users are engaged in a creative process where they repeatedly figure new things out and try different combinations
Ownership and possession	Users are motivated because they feel like they own or control something
Social influence and relatedness	Incorporates all the social elements that motivate people, including: mentorship, social acceptance, companionship, and even competition and envy
Scarcity and impatience	Wanting something simply because it is extremely rare, exclusive, or immediately unattainable
Unpredictability and curiosity	Constantly being engaged because you don't know what is going to happen next
Loss and avoidance	Motivates us to avoid something negative from happening

Secondly the purpose of the game gives limitations. The game must – in its’ part – develop and verify the skills and know-how for the officials in case of chemical maritime incidents. The scenario scripting as well as the virtual tools represented in the game must be accurate (or at least accurate enough) to ensure the use proper procedures during the actual incidents. Therefore the game must – to a certain point – represent the actual world and its’ procedures and the use of fiction to enable more elaborate experience is limited.

In practice, the game was designed to be played from the perspective of emergency response center as the actions and decisions made in it seemed the most various and most important to the process as well as because it is a task that everyone involved to the process benefits to understand. Also the educational factors were best included in this task. As the game is single-player the player must do the tasks of several persons in the response center team and thus the possibility for simultaneous events was ruled out.

The virtual tools in the game design are similar to the tools used by emergency response center: a telephone, radio, interactive chart, whiteboard, and chemical database. Whereas the real world operations take hours or even days to solve, the educational computer game should be completed in less time. Also, the game should be more intensive and therefore the time flow was simulated and the operations e.g. making a phone call or using radio advances the game time.

The game starts by introducing the current situation (i.e. mayday-call) and puts the player to the position of the emergency officer. The player can use the aforementioned tools to both gather more information about the situation and to make decisions with the aim to save the vessel and the passengers in the emergency situation. The actions cost time, which is limited, (e.g. using telephone advances the time by n minutes) as well as some actions give new options to advance. More options can also open as the game time advances, as certain time-points trigger events which update or change the information. All the decisions of the player are stored and at the end of the scenario the game gives feedback according to the decisions and the outcome from them at the end.

The game can include numerous different scenarios with different storylines, chemicals, and events written by the project group to both give variance and to further enlighten the players about the multitude of different situations encountered by the emergency response center officials.

Technically GameSAR is a browser-based application and it is created using a open source HTML5 game framework called Phaser (Photon Storm, 2018). Browser was selected as a platform as our audience has a diverse set of devices in their use. With these tool selection decisions we can support multiple platforms and devices with different screen sizes and input methods without creating separate packages for every platform.

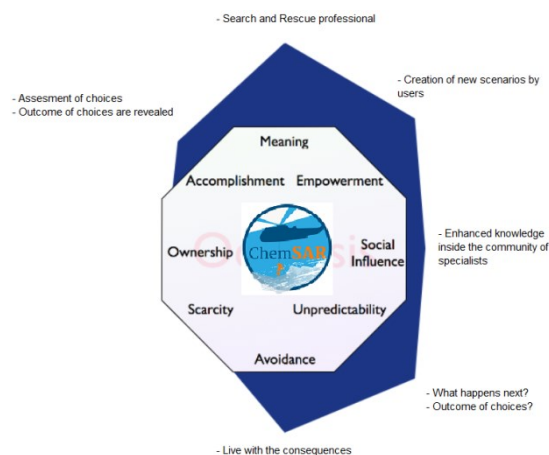
OCTALYSIS ANALYSIS

Our game is aimed to support the learning of maritime chemical rescue operations. Thus learning is the most important aspect of it and everything else should support it. To evaluate the game and its aspects intended to be motivational and engaging, we use the Octalysis model to find out the weaknesses and the strengths of the game.

The following Picture 1 shows the summary visualization of the analysis with the Octalysis tool.

In GameSAR you are training how to correctly act on a disaster event which can save lives in real-life situations. The core drive of *Epic meaning* is therefore fundamental to our tool. This aspect is valued to 8 as the potential consequences are presented to the player constantly.

On the *Development and accomplishment* the score is 3. Earlier version of the game included scoring mechanism, but after testing with the target audience it was removed as it was seen as distracting feature by them. To them the important thing was to see outcome of the choices made, and what were the correct ones.



Picture 1: ChemSAR analysis with Octalysis tool (tool provided by Chou, 2018).

For the *Empowerment of creativity and feedback* our score is two-fold. Creativity is not encouraged by the game during the gameplay, so to this aspect the score is 1. But the main outlet for creativity is the possibility to create own scenarios for others to play with simple scripting language. Hence the final score is 6.

Ownership and possession is about owning or controlling things. In our game you are trying to take the situation under your control, but you are not really owning or gaining things with your actions so we evaluate this aspect to 0 points. This is something we could improve, maybe by making the

player/learner to be more possessive on the resources they have.

Social influence and relatedness are social elements, which the game does not support directly. The game is also meant to be played in classrooms and that way social interaction between the players is encouraged. But as there are no in-game mechanics supporting this core drive, it is valued at 2.

On the drives for *Scarcity and impatience* the score is 0 points. As we are aiming for teaching real-life procedures for search and rescue operations, we do not put limitations to how long and how much the game can be played. Also, all scenarios are playable immediately.

For the core drive closest to engagement with the content, *Unpredictability and curiosity*, valuation is 6 points. Game presents players with unexpected situations to which they have to react based on their own skills. To make most out of these situations, they have to be paying attention to details and correct procedures to follow. This also relates directly to the *Loss and avoidance*. If players are not paying attention the in-game situation escalates quickly and leads to an unrecoverable situation, just like in the real world. Therefore this core drive is also evaluated to 6 points.

CONCLUSIONS

Octalysis is developed as a tool for analyzing the design of gamified services and how they appeal to different motivational factors. The main purpose of our learning game is to be an educational tool, and to support this purpose it uses design practices from games for its interface and gamification as a design guide for other aspects. But, as the game is only a part of the predetermined curriculum for learning SOPs, it is not intended to be used for prolonged periods of time. Thus the game differs from most of the services that are usually using gamification techniques to extrinsically to motivate people to use them.

According to the Octalysis framework the game can be classified as a gamified solution and therefore its design is successful. The analysis also shows which parts we might need to think about improving our design in case the user experience testing shows that the application is not engaging enough. Similarly on the lines with Economou et al. (2016) we note that Octalysis (or other gamification frameworks) should be improved or modified to fit cases where main task for the gamified service is learning, since some of the core drives are a bit difficult to apply in this domain.

Maritime HNS SAR questions are complex and, since the research being just on-going, largely unanswered thus the game setting is limited to the knowledge currently at hand. As the ChemSAR project around the game advances, more content can be implemented to the game. Due to the modular structure of the game mechanics the extra content however can easily be implemented and thus extending the life-span of the game. It is obvious that the research is still in its early phases. The team's future research will focus on developing the game according to the principles found in this research as well as continue the development by finding more information through conducting empirical research.

The game aims to be pedagogic yet entertaining and thus it is only partially realistic simulator on what the work in the response center, moreover a never-tiring teacher on different situations may one encounter and how one should react to the situations at hand. Whereas the game is still in early alpha stage there are indications that this game will indicate the possibilities of gamifying serious and even critical aspects of our society - our safety and thus it can be a recommended option in teaching those that will eventually be responsible for our lives.

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