Dynamic Pervasive Storytelling in Long Lasting Learning Games

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Abstract: Pervasive gaming is a reality-based gaming genre originating from alternative theatrical forms in which the performance becomes a part of the players' everyday life. In recent years much research has been done on pervasive gaming and its potential applications towards specific domains. Pervasive games have been effective with regards to advertising, education and social relationship building. In pervasive games that take place over a long period of time, i.e. days or weeks, an important success criterion is to provide features that support in-game awareness and increases the pervasiveness of the game according to the players' everyday life. This paper presents a *Dynamic Pervasive Storytelling* (DPS) approach and describes the design of the pervasive game *Nuclear Mayhem* (NM), a pervasive game designed to support a Web-games development course at the Nord-Trøndelag University College, Norway. NM ran parallel with the course and lasted for nine weeks and needed specific features both to become a part of the players' everyday life and to remind the players about the ongoing game. DPS, as a model, is oriented towards increasing the pervasiveness of the game and supporting a continuous level of player *in-game awareness* through the use of real life events (RLE). DPS uses RLE as building blocks both to create the overall game story prior to the start of the game by incorporating elements of current affairs in its design and during the unfolding of the game as a mean to increase the pervasiveness and in-game awareness of the experience. The paper concludes that DPS is a promising approach for creating a game story which increases the pervasiveness of the game and supports in-game awareness.

Keywords: pervasive games, game based learning, in-game awareness, interactive storytelling, media analysis, game mastering

1. Introduction

Pervasive gaming is a gaming genre in which the game is not confined to a virtual world but extend the gaming experience out into the real world (Benford et al. 2005). Many types of games, toys and experiences are labelled as pervasive (Magerkurth et al. 2005) and the boundaries between pervasive games and other types of games are unclear. Researchers have approached the genre from different perspectives which led to multiple definitions of the term *pervasive game* (Nieuwdorp 2007). This paper follows a technologically independent definition:

> *A pervasive game is a game that is pervasive relative to the player´s everyday life.*

A pervasive game is therefore required to be both spatially and temporally pervasive relative to the player's everyday life for the whole duration of the game. Given these characteristics, pervasive games can be suited to blend learning into students' everyday life and thereby bring a pervasive property to learning (Pløhn 2014). However, pervasive games face specific challenges that traditional board games or ordinary digital games do not have. While playing a non-pervasive digital game, the player is aware at all times of the fact that he/she is playing a game. In the case of pervasive games; where the game is a part of the players everyday life and last for days or even weeks (with potentially long periods of times without any game related activities), players can easily forget that they are participating in a game. Pervasive games need features to support *in-game awareness*:

> *In-game awareness is the player's feeling and awareness of participating in an ongoing game.*

Given the definition, features that support *in-game awareness* are everything that helps to remind the player about the ongoing game's existence.

In this paper we argue that an important success criterion in designing pervasive games is to provide features that 1) support in-game awareness and 2) increases the pervasiveness of the game. Since an important feature

of pervasive games is the use of the real world as a part of the game, it seems natural to use the real world and real world events to support these two properties and the research question is therefore as follows: How can real world events be implemented in a pervasive game to provide support for in-game awareness and to increase the pervasiveness of the game? To address this research question we developed the *Dynamic Pervasive Storytelling* (DPS) model/approach. DPS was used to design the game story in the game Nuclear Mayhem (NM), a playable prototype of a pervasive game designed to support a university course in the development of Web-games at the Nord-Trøndelag University College, Norway (Pløhn 2013). The duration of the game was nine weeks. Participation in the game was the only mandatory activity during the course and the students had to complete the game to be allowed to attend the exam. The requirement for mandatory participation contradicts one of the most frequently cited definitions of a game offered by Suits (Suits 1978) as "the voluntary attempt to overcome unnecessary obstacles". New applications of games, such as e.g. Game Based Learning, where participation often is obligatory, suggests that this definition is too narrow and consequently there is a need to revise the definition of "what makes a game" to include the new areas of application in the definition. This discussion is beyond the scope of this paper and we define Nuclear Mayhem as a game according to the six requirements proposed by Juul (Juul 2003), stating that an activity is a game if the following six features are included:

1. A set of fixed rules

2. A variable and quantifiable outcome

3. Valorization of the outcome

4. Player effort

5. Player attached to outcome

6. Negotiable consequences

This definition does not emphasise or include "voluntary participation" for an activity to be defined as a game. All the six features in this model are included in Nuclear Mayhem.

This paper presents the use of DPS as a strategy to create a game story to be used in pervasive games and methods to support both in-game awareness and to increase the pervasiveness of the game. Section 2 provides an overview of the narrative considerations in DPS and section 3 discusses the design requirements for the design of NM. Sections 4 and 5 present our evaluation and results.

2. Narrative considerations in dynamic pervasive storytelling

Storytelling or narrative is commonly used in both digital entertainment and serious games in order to motivate players in first engaging and then keep them engaged. Work by Lazzaro (Lazzaro 2004), Fullerton (Fullerton et al. 2004) and Yee (Yee 2005) all identified storytelling elements as key motivations for players in entertainment games. Storytelling, for similar reasons, is also regarded as a key element for the design of serious games and Lim and Louchart (Lim et al. 2014) identified a schemata (Purpose, Process, Structure) through which narrative serious game mechanics can be identified and described. In the particular context of NM, the story represents an important design factor for player motivation and keeping the player engaged, but also in terms of pervasiveness and its ability to out-reach beyond the remit of in-game awareness. For these reasons, not only does the story need to engage and motivate players like any other digital entertainment/serious game approach, it also needs to be current and timely so as to be part of the player's world outside the game. Thus gaining relevance within the real-world in which players actually live. Contrary to most gamification approaches where competition is of the essence (Deterding et al. 2011), NM's interest in blending virtual and real presences is primarily motivated by the desire to achieve narrative immersion and create an omnipresent story-world through which learning outcomes can be put into context and achieved.

In conceptualising a DPS approach, it is essential to adopt a narrative mechanism in which the story can reflect events, which cannot be pre-determined or planned. From an experiential perspective, the overall main game story should be pre-written and set within the traditional storytelling branching practices seen in most entertainment games (Wei 2011). From a pervasive perspective, however, elements of story related to the depth of the experience require some level of active, on-the-fly interventions in order to bridge or blend

virtual and real worlds. Technically speaking, a DPS experience, requires, for its whole duration to be monitored and authored from the perspective of an active game-master (GM) whose role is to facilitate the integration of story elements and the experience of players (Tychsen et al. 2009). Parts of the story therefore become emergent in nature and require the interventions of an author in real-time so as to maintain a balance or exploit opportunities (Temte and Schoenau-Fog 2012). This approach is common in the designs of modern table-top Role Playing Games (RPGs) such as Dungeons and Dragons (D&D) Series (D&D 2014) and Nordic Live Action Role Play (LARP 2014). In cases (Kanner and Lassila 2012), the game world is set in the real world in which people are oblivious to the game played by participants. The game articulation, in such a context is achieved by the combination of GM interventions and actors whose role is to exploit opportunities arising from the unfolding play or events in the real physical world over which neither the GM nor the actors have any control. NM follows a similar approach in which the GM monitors player actions within the game and the real physical world for opportunities that could be exploited or reported to players via out-of-the-game media such as e-mails, mobile phone texts or social network.

3. Design principles for NM

One of the main challenges for the story in NM was to increase the pervasiveness of the game and provide in-game awareness. The pervasive aspect of the game story is to provide a live information background contributing to player motivation rather than direct the players towards performing specific actions during the game. For instance, the NM scenario features a plot line set in the context of the escalating international diplomatic conflict related to the Iranian nuclear programme. A timely current affair topic at the time of running NM in which there was growing international scepticism on the legitimacy of the Iranian nuclear programme (RT 2009). In this context, computing students play the role of cyber-saboteurs in the wake of the Stuxnet virus attack on Iranian nuclear facilities in 2010 (CNN 2010). In this scenario, Iranian agents are sent from Iran to find and eliminate the saboteurs and as the game unfolds they are gradually getting closer to the players. During the game the "agent story" motivated several SMS messages in which players were informed about the status and whereabouts of the agents. While these messages helped to build and develop this aspect of the story, the main intention was to remind the players about the game (create in-game awareness) and help to increase the pervasiveness of the game (most people will read SMS even if they are occupied with other things) by linking game actions to real news bulletins related to this particularly current topic at the time. To this purpose, a set of specific principles was put together so as to achieve a state of story omnipresence for the duration of NM (Figure 1).
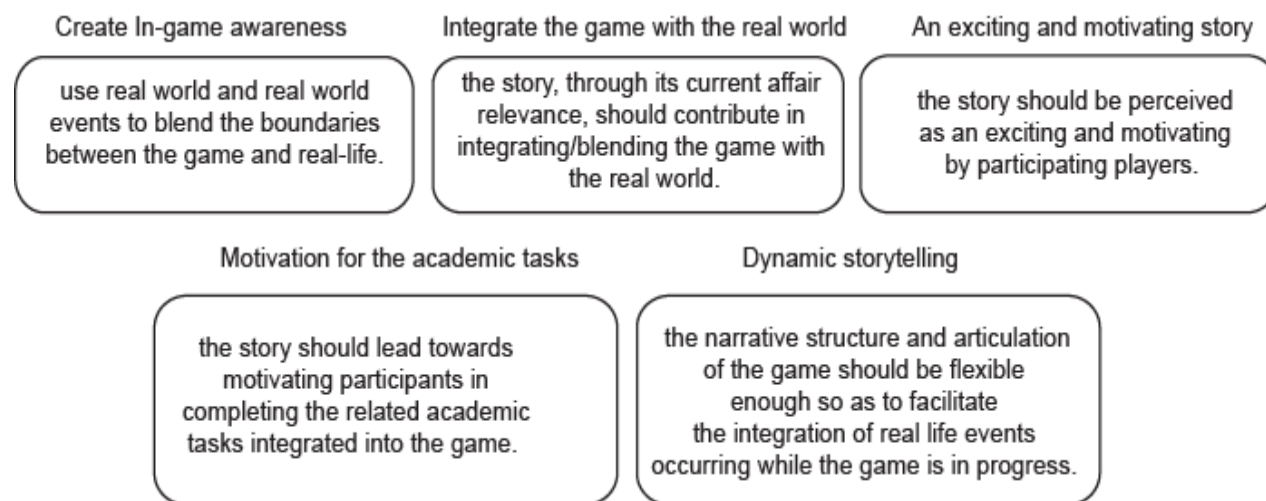

Figure 1: NM story principles

3.1 Create in-game awareness

NM is a 9 weeks long pervasive game and there are necessarily long periods with little or no game related activities. The player needs to develop a kind of information awareness so as to preserve the "feeling" of being in a game whilst not actively participating in any specifically related game activities. We refer to this as in-game awareness in the sense that a player will access or process information from the perspective that it might be related to the game and thus relevant. In-game awareness in pervasive gaming has many similarities

with awareness in computer-supported cooperative work (CSCW). Awareness as an achieved outcome is a critical element of any cooperative work situation (Fitzpatrick 2003). Surveys within the CSCW community have identified up to nineteen different types of awareness information (Cabitza and Simone 2007), but one type of awareness that is special for pervasive games is related to the fact that one is participating in a game (in-game awareness) as opposed to the awareness that one is at work which is the case for CSCW.

The pervasive game *SupaFly* supported in-game awareness by using the players' geographical proximity to each other to make the players aware of other players in the surrounding geographical area (Jegers and Wiberg 2006). This approach is not relevant in *NM* since the game play does not put the same emphasis on the players` physical location towards each other - the main feature in NM to support in-game awareness is the game story itself.

Since pervasive gaming is a new genre, there is still a lot of research needed to find out how in-game awareness can be supported in pervasive gaming. Our techniques to support *in-game awareness* are identified in Figure 2:
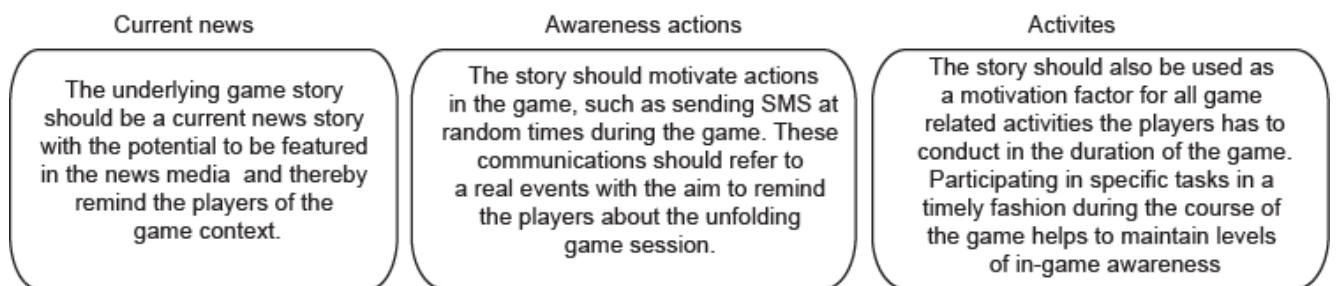

Figure 2: In-game awareness story techniques

3.2   Integrate the game with the real world

One way to achieve this is to create a game story that incorporates real life events as a part of the game story. Many of the design methods used to support in-game awareness will also contribute towards increasing the pervasiveness of the game and blend the game into the players' everyday life.

For instance, when the player, in the evening is watching the news on TV and see a news story directly related to the game story, this will remind the player of the game in a non-game related situation (create in-game awareness) but will also help to blend the game story into the players everyday life and thereby increase the pervasiveness of the game. The same properties of the game story that support in-game awareness will therefore also help to increase the pervasiveness of the game, but – to be able to create an overall game story that is based on real life events – the following properties should also be supported in the chosen story (Figure 3):
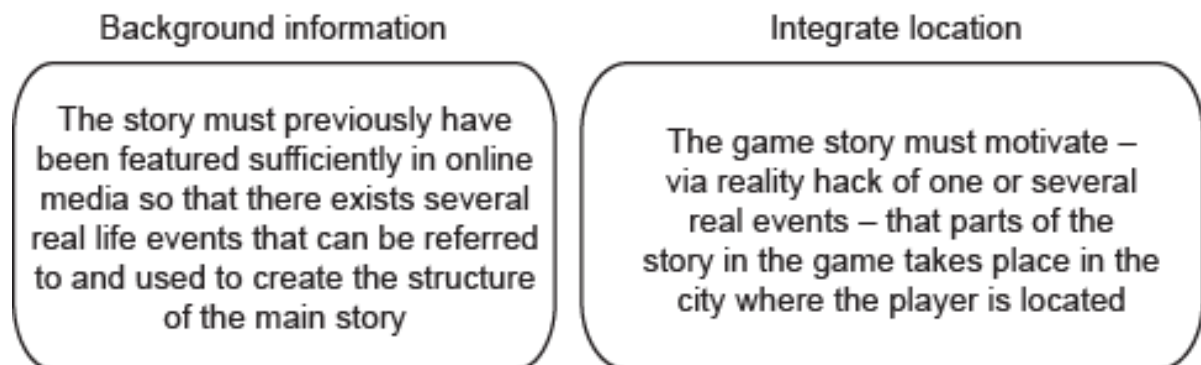

Figure 3: Story blending techniques

3.3   An exciting and motivating story

The game story is an important design factor to create player enjoyment and motivation to play the game. Player enjoyment is a crucial factor in successful game designs but little work has been done in the research area of pervasive gaming to address this. The *Pervasive GameFlow Model* (PGM) (Jegers 2007) which is derived from the general *GameFlow Model*, was introduced to develop a better understanding of player enjoyment in pervasive game. PGM does not mention storytelling specifically but outlines the following eight elements as important factors to create player enjoyment in pervasive games:

- Concentration (the game should require concentration and the player should be able to concentrate on the game)

- Challenge (the game should be sufficiently challenging and match the player's skill level)

- Player skills (the game must support player skill development and mastery)

- Control (players should feel a sense of control over their actions in the game)

- Clear goals (the game should provide the player with clear goals at appropriate times)

- Feedback (players must receive appropriate feedback at appropriate times)

- Immersion (players should experience deep but effortless involvement in the game)

- Social Interaction (the game should support and create opportunities for social interaction)

PGM is not a final and fully comprehensive model but can be regarded as a starting point for further empirical studies on player enjoyment in pervasive games. However, even if the model is not yet complete, it is thus far the most valid model dealing with player enjoyment in pervasive games. Thus, in order to support player enjoyment, we argue that a game story should support, as best as possible, the eight elements in PGM.

3.4   Motivation for the academic tasks

In many games used in game-based learning (GBL), the ludic experience is often suddenly interrupted in order to feature an academic section in which the player must perform some academic. We believe that the "educational part" of the game used in GBL should be an inherent and integrated part of the game and not be perceived as something different or unrelated by the player. To achieve this, the game story must provide clear motivations for the completion of related academic tasks. In NM, this is achieved through the established fact that the academic tasks are the main reason as to why the player is "contacted" and asked to "play the game".

3.5   Dynamic storytelling

Since we planned to feature relevant real-life events during the game, the game story had to be flexible so as to accommodate those events as an inherent part of the game story. As discussed in section 3.1, this is an important strategy towards in-game awareness and the approach undertaken in NM was to create an overall game story based on previous real life events (as mentioned in chapter 3.2) that form the complete game story (if nothing happens in the real world that can be related to the story) or offer opportunities to explore different aspect of the game topic. If such a case occurs, the technique selected is the classic digital game approach in which the main storyline can be put aside temporarily in order to allow for the development of an arising story line (based on timely real-life events) until the story branches back again to the main overall storyline as shown in the figure below. This is in itself a very common digital game technique in which micro-narratives are inserted within the overall macro-level narrative of the game (Grant and Bizzocchi 2005). In the particular case of NM, the narrative at the macro-level is not per se flexible as its elements are designed to appear in sequence according to the demands of the educational curriculum. The micro-level narrative however can be slotted in as they occur in real-time in the real-world current affairs. The role of the game master (GM) is thus both opportunistic and creative in the sense that it is up to the GM to scrutinize media for relevant news reports and assess the opportunities these could provide with respect to enriching the pervasive game experience.
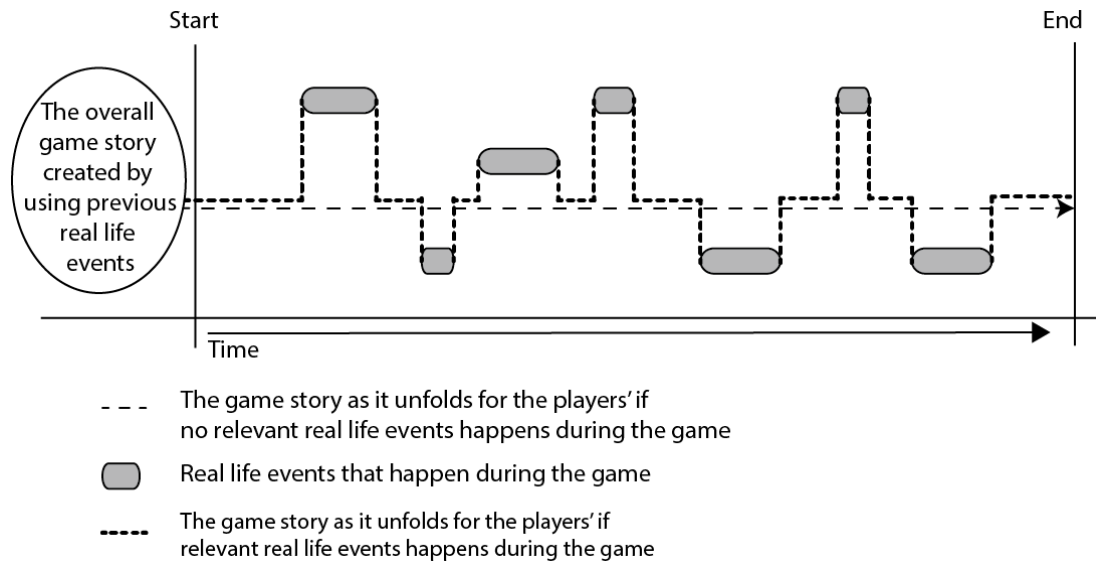
Figure 4: Using real life events to create the game story

4. The game story – DPS in practical application

In this chapter we describe the overall game story and examples of the game story to illustrate the DPS approach described in section 3.

Media analyses of the current and former media landscape suggested that Iran's alleged nuclear weapons program was a relevant candidate as the theme for the game history. At the time, Iran's alleged nuclear weapons program was often mentioned in the news. There had already been a number of different events that could be used to substantiate the game story, and the issue seemed to be so relevant that there was great probability that one or more events could happen, in the duration of the game, that would be featured in the news media and thereafter could be implemented in the game (Figure 1). On the basis of these considerations the theme chosen for the game story was Iran's nuclear program.

4.1 The overall game story

The overall game story was constructed from the ability to support the story by referring to real life events that had already happened (reality hack), and the likelihood that there would happen something related to the story that would be referred to by the news media (newspapers, television) and would be possible to implement as a part of the game story or game plot while the game was in progress (Figure 2). Based on the above, the overall game story was constructed as follows:

> Iran has a nuclear weapons program which aims to develop nuclear weapons (RT 2009, Nettavisen 2004, Dagbladet 2010). A group of agents has been asked to delay and sabotage the weapons program so that Iran does not succeed in developing nuclear weapons. We do not know the identity of the members of this saboteur group but they use the identity of a non-existing person, Amir Ahangar, as their contact. The saboteur group has previously managed to delay the nuclear program by liquidating key personnel (AFP 2010), but this is no longer a feasible option.
>
> In an underground bunker in Iran there is a supercomputer that is currently conducting computations that are absolutely necessary for the Iranian nuclear weapons program. Without these calculations, it will not be possible for Iran to develop nuclear weapons and the saboteur group's mission is to sabotage the super computer before the calculations are completed.
>
> To gain access to the supercomputer, the saboteur group has to hack into Iran's government internal computer network. The group has managed to gain access to an Iranian government office in which there is a computer connected to the internal computer network, but they do not have the codes and passwords necessary to penetrate the network and get access to the supercomputer.

These codes are however known to Shahram Amiri, a former Iranian nuclear physicist, who fled to the United States in a CIA coordinated operation (VG 2010). The saboteur group has to somehow contact Shahram Amiri to get the secret codes to the gain access to the supercomputer.

4.2   Integrate location

The probability that the selected theme for the game story unfolds at the same physical location as where the players live their daily lives is most likely very small. A very important part of pervasive games is to use the players' surroundings, i.e. the city, school/work, home, as an integrated part of the game play; hence there is a need to co-locate the game and the players. The game story must therefore substantiate that the game (i.e. the part of the game where the players has to get involved) happens where the players live their everyday lives, even if most of the game story (what the players can see on national TV, read about in newspapers etc.) unfolds somewhere else in the world. The game was co-located (figure 3) with the players by the following twist in the game story:

> The Iranian nuclear physicist, Shahram Amiri, which fled to USA (VG 2010), is regarded as a traitor by the Iranian government. They have sentenced him to death and Iranian agents have been sent out to locate and liquidate him. To protect Shahram Amiri from assassination, he has, in consultation with the Norwegian and American government, in utmost secrecy been placed in Steinkjer with a new and top secret identity as Afghan asylum seeker.

This part of the game story, which is designed on the basis of both real and fictional events, integrates the game with Steinkjer (the city where the Nord-Trøndelag University College and the players are located) and provides the reason for why the players must be involved in the game. The "Amir Ahangar" saboteur group, which is located in Iran, needs help from someone located in Steinkjer.

4.3   Provide motivation for the academic tasks

The game story should provide motivation for the academic tasks that the students have to perform in the duration of the game and integrate the academic tasks in the game in such a way so that the players (figure 1) perceive them as an integrated and natural part of the game. Following the DPS approach the academic tasks in Nuclear Mayhem is integrated in the game (Pløhn 2014) by the following part of the game story:

> The former nuclear physicist, Shahram Amiri (VG 2010), who now lives in Steinkjer under a false identity as an Afghan asylum seeker, is willing to help penetrate the Iranian government data network by providing the passwords and codes necessary, but to protect himself, he will not have any direct contact with the "Amir Ahangar" saboteur group. He has instead chosen to hide the codes at different places in Steinkjer, and to prevent them from being discovered and understood by random people, he has hidden the codes included in a technical challenges that not just anyone will understand. Apart from this, Shahram Amiri will not help in any way. He fears, with good reason, for his life and will not do anything that could cause the Iranian authorities to become aware of him.

> The codes turn out to be hidden behind, or as part of ActionScript 3.0 programming code and Flash applications.

> This means that the "Amir Ahangar" saboteur group has to find someone in Steinkjer, with knowledge of Flash and ActionScript 3.0 programming, which are willing to help the saboteurs by revealing and transmitting the codes to them so they can penetrate the computer network and sabotage the supercomputer before it has completed the calculations.

> Via searches on Google and thereafter on www.hint.no, the "Amir Ahangar" saboteur group discovers that there is an ongoing ActionScript 3.0 programming course at the SPO program at Nord-Trøndelag University College in Steinkjer, and they decide to contact the students there to get help to find the codes. The saboteurs group creates a false G-mail account under the name Amir Ahangar (a normal name in Iran) and use this to contact the students. The game has begun.

This part of the game story integrates the educational part with the game by making the academic tasks the only reason why the players are contacted by the saboteur group and asked to help (play the game). Everything else in the game, the riddles, the tasks, the assignments, etc. is only a result of this.

4.4 Awareness and Pervasiveness actions

One criterion for choosing the current theme as the basis for the game story was the likelihood that relevant real-life-events related to the theme and referred to by the news media, would happen in the duration of the game (section 4.1). However, there is no guarantee that such events will occur, and the game story should therefore provide a motivation for pervasiveness and in-game awareness enhancing actions in the duration of the game (figure 2). To meet this requirement the Iranian secret agents (introduced in section 4.2) were included in the game story:

> The Iranian government has sentenced Shahram Amiri (VG 2010) to death and has therefore sent secret Iranian agents out in the world to locate Shahram Amiri and kill him. When the game begins the secret Iranian agents are still in Iran but for each week of the game they come nearer and nearer in locating Shahram Amiri and identifying his helpers (the players) and they also come closer and closer to Steinkjer for each week. The last period of the game the Iranian agents are in Steinkjer and at some point, even at the University Campus (YouTube 2014).

In the duration of the game this part of the game story motivated several pervasiveness and in-game awareness enhancing actions by sending emails and SMS to the players informing them about topics such as: "The Iranians have sent two agents to Europe to locate and eliminate Shahram Amiri and anyone who helps him"; "...we now have confirmed information that the Iranian agents are located somewhere in Scandinavia", "...the agents are now in Norway", and so on.

4.5 Incorporating occurring real life events

In the duration of the game several real life events occurred that was incorporated in the game story and used to motivate several different game related actions. Due to limited space, only one example is presented in this section.

Some weeks into the game Farzad Farhangian, an Iranian diplomat at the Iranian embassy in Brussel, Belgium, defected to Norway, seeking asylum on the ground that his "life was in danger in Brussels" (BBC 2010). This became a major news story in Norway and was featured in newspapers and national radio and TV. This real life event was incorporated in the game by the following game story:

> Farzad Farhangian had been the source to information about the Iranian secret agents and their whereabouts. Farzad was in fact a member of the "Amir Ahangar" saboteur group and acted as a double agent. He had been revealed as a spy by Iranian authorities and had – at the last possible minute – escaped from the embassy in Brussels and fled to Norway to save his life. The disclosure of Farzad as a double agent has led to that the "Amir Ahangar" saboteur group have lost control of the whereabouts of the Iranian agents.

This event was used in many different ways in the game. It was featured in the early morning news on the radio and the game master who rated this as an event with large probability to be featured in the evening news on national TV and from this assessment sent the following SMS to all the players two hours before the newscast on national TV picked this up:

> One of our main information sources to Iranian internal Intelligence is Mr. Farzad Farhangian, a diplomat at the Iranian embassy in Brussel. Mr. Farhangian has provided us with Intelligence about all types of Iranian activity in Europe. His connection to us has now been exposed and to save his own life he had to flee from Brussel seeking asylum from Norwegian authorities. More about this at the news broadcast on Norwegian TV tonight.

This SMS had several purposes in the game. The SMS itself helped to increase the pervasiveness of the game and helped to create in-game awareness about the ongoing game. The SMS also functioned as a narrative since it revealed a new part of the game story to the players. The SMS led all the players to watch the evening news on national TV where the event was one of the headlines and received major focus. When the players could watch the game story "unfold" on national TV this clearly helped both to make the game more real/exciting and to increase the pervasiveness and in-game awareness properties of the game. Furthermore, this event was used as a motivation for the players to perform a practical task to ensure that they were not followed or revealed by the secret Iranian agents. This part of the game story and the practical task did not

exist before this real life event occurred and could be incorporated in the game story and game play while it happened due to the DPS approach.

5. Participants, methods and procedure

17 male students were attending the University Course that *NM* is designed to support and all registered as players in the game. None had any previous experience of pervasive gaming. Amongst registered participants two did not participate in the game and did not attend the lessons or lab-exercises. One completed the game but did not attend the final exam giving a total of 15 who played and completed the game and 14 who attended and passed the final exam.

We gathered four different types of evaluation data (qualitative questionnaires, interviews, log recording, GM observations) during the nine weeks it took to play NM. All participants answered the questionnaire (n=15). While such a small sample will not allow for statistically significant results, the analyses of responses may still provide an indication of the players' opinion for the design of future pervasive games. Based on the responses, five people were chosen for in depth interview. The five interviewees were chosen based on their attitude towards the game (two positive, two negative, one neutral). The in-depth interviews were conducted after the exam grade was set and mainly dealt with the participants' general attitude towards their experience of participating in the game *NM*, the individual game plots, the use the real world as part of the game and what they perceived as motivation or demotivation factors in the duration of the game.

6. Results and discussion

The strategy of using a current news story with the potential that timely and related real-life events could happen and be featured in the news media within the duration of the game proved to be successful. In the nine weeks period during which the game lasted, several real life stories were featured in the news media. These were used in different ways in the game in order to increase the pervasiveness of the game and maintain the players' in-game awareness.

The quotes in Table 1 illustrate how players perceived the relationship between the game and real-life news stories. They also seem to indicate that the validity of this strategy as a good design choice and an efficient and recognised way to support *in-game awareness*. Players were, at the time of consuming relevant information, in a non-gaming situation (watching the news or reading the newspaper in the comfort of their own home). They were, however, still aware of the game when reading newspapers or watching TV-news as they developed the expectation that "something was going to happen in the game" when they felt news events would be relevant to the game (see Table 1 (subjects B and E)).

However, many participants were less aware of current affairs and paid very little attention to news broadcasts on TV or newspapers. Thus, these players did not experience the same level of *pervasiveness* and *in-game awareness* as those who witness the "game story" being featured in real life news media. Our approach to remedy to this problem was for the game master to send SMS-messages informing participants to watch the evening news when there was a high probability that something was going to be featured in one of the news stories. One example of such an event was the story of an Iranian diplomat at the Iranian embassy in Brussels seeking asylum in Norway (i.e. where NM happened) (BBC 2010). This event was considerable and would almost certainly be featured as a main story to be reported during that evening's TV news show at 9 p.m. To motivate players a SMS reminding participants to watch the news show was sent to all of participants at 5 p.m.

The intention behind this SMS was to connect the real life event to one of the stories in the game (the secret Iranian agents that are constantly getting closer and closer), to create *in-game awareness* (the SMS itself) and to increase the pervasiveness of the game by motivating the players to watch the evening news and witness the "game story" being featured as one of the headlines.

Table 1: Quotes from participants about the use of the real world events in the game.

I was aware of that what I saw in the videos, the news clips etc. used in the game were real life events. I think that the use of real life events as a part of the game makes it all the more realistic ... or more real ... I think that, for my part, that the fact that real life events that occurred while the game was going on – like the Iranian diplomat who defected – was used in the game made it more real ... when you connect it to more realistic stuff so ... it increases the tension as well. I tried to play the game as if it was for real. My main motivation to play the game was the whole "concept" of the game. I think the story was exciting and fun. - Subject A (positive)
I think the story was a good plot and there was a lot of work put into it. The story matched with a lot of things that was going on at once. There were real things going in the current news that the game linked to. When I received links or tips from the game I paid more attention to the news stories about Iran, and there was a good timing on some of it. I think that the use of real life events in the game was good. It made it the more exciting ... thus … I am not just negative to the game, I can see the relevance of the game but I don't like this types of games I saw something about it on the news broadcast on TV and then I knew that things were going to take place in the game also. - Subject B (negative)
The story was well substantiated, it was well made and the details were good. I am negative to many things in the game but regarding the storytelling in the game, I am positive, The use of real life events in the game story was exiting and it increased the atmosphere of the game. - Subject C (negative)
I think the story was relevant. It was very relevant when they hacked the Iranian nuclear facilities with the Stuxnet virus. Then I thought of the game when I saw it in the news. My participation in the game made me become more aware of this type of news. I think that the use of real life events (such as the Iranian embassy employee that fled) was good because it made the story more believable. Being able to read it in the newspapers made it a bit more credible. Real. - Subject D (neutral)
When I saw the story featured in the newspapers I knew that something was going to happen. My participation in the game made me become more aware of news that could be related to the game. The story was exciting. I think the use of real life events as a part of the story might be good ... then it becomes a little more realistic ...   - Subject E (positive)

The quotes presented in Table 1 above indicate that the DPS approach was successful in creating a game story that incorporates real life events so as to support in-game awareness and game pervasiveness. All players noticed that real life events were used in NM and viewed this as a positive aspect that made the game more realistic and exciting.

A minority of players expressed a negative attitude towards NM but observations during the game and in-depth interviews showed that dislike was not caused by the game story but by other factors:

- They did not appreciate that participation in the game was obligatory (but so are the alternative which is obligatory assignments)

- The fact that they had to play a game led to them disliking the game

- Some judged that there was not enough "academic learning" in the game (curriculum issue rather than the game design).

Any complaints from the players regarding the academic tasks were, as mentioned in the bulleted list above, related to curriculum issues, and not how the academic tasks where incorporated in the game and game play. None of the players indicated, neither in the duration of the game, in the questionnaire nor the in depth interviews, that the academic tasks felt as an alienated or an unnatural part of the game.

Some players reported that their participation in the game led to increased attention if the story was featured in the media. Higher awareness about the news broadcasts was not an intended goal but it indicates that the use of real life events featured in the news media did increase the pervasiveness of the game and helped to create in-game awareness among the players.

After this experimental run of *NM*, 46.7% answered they preferred the game to the obligatory assignments, 33.3% still preferred obligatory assignments to the game and 20.0% indicated that they don't know or that it is not important. The fact that more participants preferred the game is a very good result considering that the "academic challenges" could have been designed in order to reflect on individual skill levels better. NM was a "low budget" experimental game with limitations and could have been better (some of the plots were too similar, there were periods in the game with little activity and too few assignments, game mastering was done manually and player events was sometimes not detected by the game master causing the affected players to fall behind in the game). Academic tasks could have been incorporated better and a more "fancy" and better use of technology towards a fun game-play experience would most likely make a difference too.

7. Conclusion and future work

The main contribution of this paper is the outline of a *Dynamic Pervasive Storytelling (DPS)* approach which can be used within a story creation process towards dynamic game stories in which real-life events support game pervasiveness and help to create and maintain in-game awareness.

NM demonstrates that we succeeded in selecting a suitable media event/news story to be used in the DPS approach to create a game story with the properties required.

The DPS approach also seemed successful in incorporating the academic tasks in the game in such a manner that the players felt that the academic tasks were a natural and integrated part of the game. Future versions of the game should address how to design good learning tasks that are tailored to the individual players' knowledge level.

Given NM's low budget and technological limitations, a discussion should take place as to potential impact of advanced technologies (i.e. Artificial Intelligence, Gaming technologies) on the overall user experience. The emerging domain of *Dynamic Pervasive Storytelling* for education is, as of today, confined to ad hoc and low technology designs but would certainly benefit from research in synthetic agent actors (Weallans et al. 2012) and advanced digital interactive storytelling systems (Thue et al. 2010). In this context, synthetic agents could be effectively playing autonomous roles within the remit of the storyline and choose to communicate of their own accord with participants, thus facilitating the concept of in-game awareness presented in this article. Such technologies are already available (Keysermann et al. 2012) and could be effectively deployed within the context of this work.

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