On the Development of Serious Games in the Health Sector
A Case Study of a Serious Game Tool to Improve Life Management Skills in the Young

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Abstract: The current research focuses on serious games (SG) in the healthcare sector. The objective was to identify the key phases in the design and development of SG and to study how serious game design takes into account affective computing. The case study describes the development of *Game of My Life* (*GoML*), a visual novel aiming to support the life management skills of adolescents. The game was developed in two phases using iterative agile methods in cooperation with different stakeholders. The evaluation indicates that *GoML* can be used as an effective discussion tool for professionals and patients in nursing and youth work. The results support our existing knowledge of SG development and reveal that SG design takes into account affective computing by nature: game design deliberately influences emotions in order to engage the players.

1 INTRODUCTION

Games can work as motivators and help to change players' behaviour (Baranowski et al., 2013; Ryan et al., 2006). Digital games create a structured conflict and provide an entertaining process for players to resolve this conflict (Fullerton, 2014). Video games allow the possibility not just to tell a story but also to allow a player to live it (Rigby and Ryan, 2011).

Our research goal was to identify the key phases of the design and development of serious games (SG) with respect to affective computing. The research goal was met with the help of two questions: What are the key phases when designing and developing SG? How does SG design take into account affective computing?

Various definitions of serious games exist, but it is commonly stated that SG refers to *using games and game technology for purposes other than pure entertainment* (Djaouti et al., 2011; Susi et al., 2007; Zyda, 2005).

Serious games in healthcare may be one strategy for coping with the increasing challenges of ageing populations and chronic diseases (Arnab et al., 2013). Related to this, Kemppainen, Korhonen and Ravelin (2014) point out that health games can provide a new method for maintaining and developing the health capability of different age groups. An important goal of health games is to provide new kinds of models for self-help or rehabilitation (Kemppainen et al., 2014).

Affective computing (AC) aims to close the communicative gap between human emotions and computers by applying systems that recognise and adapt to the user´s affective states. Computer games usually provide very dynamic forms of human–computer interaction since they are designed to offer affective experiences that are influenced by player feedback (Iovane et al., 2012; Yannakakis and Togelius, 2011).

This paper presents the development of *Game of My Life* (*GoML*) as a case study and is organised into five major sections. Following this introduction, the next section reviews the related work on serious games. Section three presents the design and development of *GoML*. Section four offers a discussion, and section five provides conclusions.

2 RELATED WORK

This chapter presents the earlier knowledge related to the current study. First, affective computing and games are explained, followed by aspects of game

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design and serious games in healthcare. Finally, the visual novel is introduced.

2.1 Affective Computing and Games

Computer games provide a valuable research setting for human–computer interaction research, particularly with respect to their design, interfaces and design processes (Yannakakis and Togelius, 2011). As games often offer emotional experiences, they are a good example of affective computing (Yannakakis and Togelius, 2011). In 1995, Picard defined affective computing as "computing that relates to, arises from, and deliberately influences emotion" (2010, p. 11). Yannakakis, Isbister, Paiva and Karpouzis (2014) suggest that computer games can best realise affective interaction. The rich content of games, consisting of music, sound effects, audio, virtual graphics and game mechanics, provides obvious triggers for raising the emotions of players (Yannakakis et al., 2014).

Research on player motivation attempts to establish the psychological needs that games satisfy and how different games fulfil these needs. This provides information about both the positive and negative experiences within games (Rigby and Ryan, 2011).

Malone and Lepper (1987) identified four major factors that make a learning environment such as a gaming activity intrinsically motivating: challenge, curiosity, control and fantasy. These individual factors motivate a player when playing alone, while interpersonal factors such as cooperation, competition and recognition motivate a player when interacting with other players (Malone and Lepper, 1987).

The Player Experience of Need Satisfaction (PENS) model details the satisfactions that hook players to games. This model is based on the fact that video games are considered most engaging when they satisfy specific intrinsic needs: competence, autonomy and relatedness. *Competence* refers to our desire to grow abilities and gain mastery of new situations and challenges. Digital games easily provide highly engaging experiences in rich virtual worlds, which brings immediacy and can satisfy motivational needs such as competence and mastery. *Autonomy* refers to our desire to take actions based on our own decisions and not to be controlled by others. There is a certain consistency in games: once a player learns the rules, the outcome will consistently reflect the player's actions and expectations. *Relatedness* reflects our need to have meaningful connections with others (Rigby and Ryan, 2011). Density refers to the ability of games to deliver competence and the other needs at a high tempo and with a well-built feedback system.

2.2 Game Design Aspects

Designing digital games involves psychological aspects (Rigby and Ryan, 2011) as well as mechanical and artistic aspects (Fullerton, 2014). According to Rollings and Adams (2003), game design is a process that includes imagining a game, defining how it works, describing its elements and transmitting all this information to the game development team. A common element in digital game design is designing systems of actions and outcomes where the game responds easily to a player's input (Salen and Zimmerman, 2004).

The process of video game design involves designing the content and rules in the pre-production stage and designing the gameplay, environment, storyline and characters in the production stage (Bethke, 2003; Fullerton, 2014). Adams (2013) divides the game design process into three parts: the *concept* stage, which is performed first; the *elaboration* stage, where most of the design details are added and refined; and, finally, the *tuning* stage, which involves polishing the game.

2.3 Serious Games in Healthcare

Social security systems and healthcare providers differ among various countries and on a global scale, with each market area having its own methods for facilitating a healthy lifestyle (Kaleva et al., 2013). There are many different stakeholders in the health game market: hospitals, clinics, private practice physicians, governments, corporations, other organisations and individual consumers (Susi et al., 2007).

Braad, Folkerts and Jonker (2013), Friess, Kolas and Knoch (2014) and Deen, Heynen, Schouten, van der Helm and Korebrits (2014) have all used similar processes in serious game development in the health sector. These processes all include a strong research and analysis phase at the beginning. Involving different stakeholders is also essential. An iterative development process (or prototyping) is used, along with user-group testing and an evaluation or validation phase at the close of the game development process.

Supporting players' motivation and enhancing behaviour change are key points in health game design (Rigby and Ryan, 2011). It is essential to use game elements like surprise and simulation to engage players and enable immersion (Adams, 2013). In addition, developing a health game needs a multidisciplinary team to work successfully together (Kemppainen et al., 2014). Brox, Fernandez-Luque and Tollefsen (2011) suggest that it is important to:

1. define both the target group and the main objective;
2. design a game accordingly, using sound game design principles;
3. utilise design elements to enhance learning and persuasion;
4. collaborate with health professionals from an early design stage;
5. involve patients, especially to improve usability.

Iterative design is a play-based design model. It emphasises playtesting and prototyping, which allows players to be part of the game design. In iterative design, a rough model of the game—a rapid, interactive prototype—is created as early as possible. This may have placeholder graphics, but it can be played and evaluated. The user comments and evaluations influence the game's further design (Salen and Zimmermann, 2004).

When designing serious games in healthcare, the target group should be taken into account during the development process (Brox et al., 2011; Braad et al., 2013; Friess et al., 2014; Deen et al., 2014). Professional knowledge is an essential part of the development (Merry et al., 2012).

It is essential to include an assessment of serious games' usefulness and effectiveness in the development process (Graafland et al., 2014). Desurvire, Caplan and Toth (2004) outline a set of design heuristics, which are guidelines that serve as an evaluation tool specific to video games. According to their definitions, the Heuristics for Evaluating Playability (HEP) categories include: evaluating game play; game story—plot and character development; game mechanics; and game usability. HEP is recommended for use in the early design phase (Desurvire et al., 2004).

2.4 Visual Novel

A visual novel is a *narrative-based digital medium* that players can guide by making decisions, thus altering the outcomes**.** According to Lu (2013), it enables a collective participation experience, even though it is usually played alone. A visual novel is more like a role-playing game than a simulation (Cavallaro, 2010; Lu, 2013).

A visual novel consists of a soundscape, static graphics or animations, immersive storytelling and interactive decision-making moments that allow the player to decide how the visual novel progresses. The pace of the game's progress is slow, and this gives the players time to process their thoughts during the gameplay. The genre is dependent on narrative and dialogue. An engaging video game narrative enables a personal experience for the players and creates their affection for the characters (Cavallaro, 2010; Gabriel and Young, 2011; Lu, Baranowski, Thompson and Buday, 2012; Lu, 2013).

3 CASE STUDY: DEVELOPMENT OF *GAME OF MY LIFE*

Game of My Life (*GoML*) is an online game in a visual novel style that aims to support the life management skills of adolescents aged 16–19 years.

3.1 User Needs and Analysis

The need for the game arose from youth psychiatry experts who wanted new tools for approaching their young (16–19 years) patients. The main objective was to create a game that could be used as a tool in conversations between experts and patients regarding life management issues. The experts suggested that the game be based on the Finnish theoretical framework by Ylitalo (2011). This framework describes a role map of a young person in the process of becoming independent. The role map (Fig. 1) includes five motivation roles, with subcategories for goal-oriented roles and action roles.

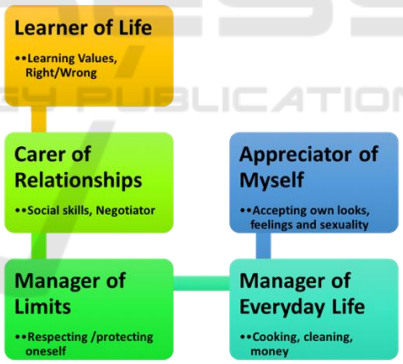

Figure 1: Role map of a young person in the process of becoming independent.

The game development process began by searching for existing games in the market. The most promising at the time (2012) was a PC game called *SPARX*, which had been developed in New Zealand for the treatment of mildly depressed adolescents and used as a stand-alone self-help intervention. After testing, it was decided that this game was not the kind of tool that the youth psychiatry experts were looking for to help in discussion with young patients.

The next step was to gather more information about the life management skills of adolescents from their own point of view, particularly regarding

problems related to mental health and substance abuse. This was done by qualitative research into six young persons who participated in individual semi-structured theme interviews. The research focused on how these young people understood life management and what challenges they had with it. It also gathered their expectations for a game supporting life management. The results showed that the young people had difficulty understanding the term *life management skills* but found it easier to understand when it was called *managing your everyday life*. The participants hoped that the developed game would provide information on substance abuse, as well as on the use of time and money.

These activities formed an analysis phase that consisted of:

1. Cooperation with health professionals: carrying out a preliminary requirements analysis that defined the target group and the main objective of the serious game being developed.
2. Quick market research into similar products.
3. Testing and reporting on the most significant similar products.
4. Involving end users in order to find the most problematic aspects that needed to be covered in the game.

3.2 Game Concept

After understanding the user needs, the focus moved to user–computer interaction and the game concept design. It was decided that *GoML* should be a network game, playable in a prototype phase on the most used browsers and Android tablets. After a literature search, a visual novel was selected as the game genre. A visual novel can evoke feelings in players, thus making it the powerful tool that the experts were looking for. The narrative of the visual novel had three characters (two male, one female), all with three different storylines relating to their school, home and free time. Each of these was based on the "role map of a young person in the process of becoming independent" (Fig. 1). To get a feeling of interactive decision making, decision paths were planned according to the storylines, with players guiding the narrative by choosing from multiple choices with a mouse (PC) or by tapping their finger (tablet). It was agreed that, in order to provide additional information, there would be external links at the end of each storyline.

Restrictions due to budget, resources and timing meant that this was a visual novel without soundscape, with the maximum gameplay time for each storyline limited to 15 minutes. The graphics for *GoML* were simple and static and had a cartoon look with a user interface like a book and easy-to-use buttons.

The above features created the **game concept** for this serious game, which could then be used for further content creation.

3.3 Content Creation for the *GoML* Demo

Serious games development uses a standard game design process to develop an immersive game. This involves designing the game play and flow as well as the interactive narrative and dialogue.

The development of *GoML* began by finding an appropriate art style and writing the first storyline. The first team, consisting of three game development students (a game designer and producer, a programmer and an artist), developed the first demo version during 2012.

The game design began with ideating among the team and with a nursing lecturer and her students to get more accurate content. The nursing students brought valuable information about patient needs to the process. The ideas were also presented throughout the project to several stakeholders, including youth psychiatry experts and game development professionals. The game design document covered the main idea for the whole game, but it was decided that only the "Home" level of one character could be included in the demo version. The design of the visual novel also included the story writing, in which themes from the "role map of a young person in the process of becoming independent" influenced the content. The art style was kept simple; it was cartoonish and used light colours that would bring a positive atmosphere to the game.

Since the game mechanics were simple and used a web-browser platform, the production was carried out using Adobe Flash. This allows for quite rapid programming, and the executables are easily available online.

The development process, as illustrated in Figure 2, was iterative, adapting forms of agile development such as scrum. This enabled quick prototypes to test the ideas so that the game could be presented to different stakeholders.

After testing and feedback, the development continued further. In several iterative steps, the demo of *GoML* was presented to youth psychiatry experts and tested by experts and patients; it was also evaluated by an external professional.

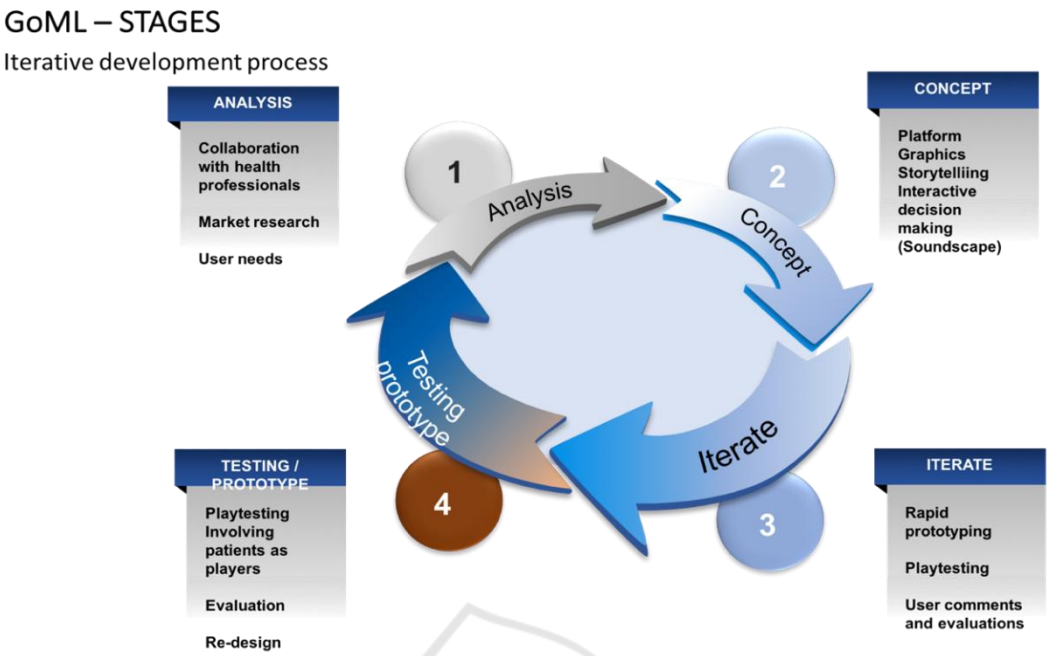

Figure 2: The iterative development process with *GoML* stages.

3.3.1 Testing of *GoML* Demo

The first playable *GoML* demo (see Fig. 3) consisted of one storyline and one level ("Home") relating to one main character. The game was tested by youth psychiatry experts and some of their patients, but due to the limited content of the game, the main feedback from the testing concentrated on suggestions for improvement.

Figure 3: Concept art for *GoML* demo.

A psychology student from the University of Chicago worked with the project team by providing information related to the visual novel. He also carried out, as part of his studies, a more comprehensive analysis of the SG demo using a modified version of the Heuristics for Evaluating Playability (HEP). This included areas of game play game story, game mechanics and usability with several claims in each area. Claims were assessed by using ratings in the range of 0–3 (0 = not found in game, 1 = poor, 2 = fair, 3 = good/excellent) and providing a written description, if applicable. The main result of the evaluation was that the HEP results could be used as a good base for the next phase of the development of *GoML*.

3.4 Content Creation for *GoML*

The second phase of the *GoML* development started in 2014 with a new game development team. The extended project team also included a nursing student and two senior lecturers (in game development and nursing and healthcare).

The new multidisciplinary team began by analysing the developed demo version and gathering the testing and evaluation results. Based on these, the major lines of development were decided upon and prioritised. It was understood that the available time and budget would limit the outcomes.

A booklike graphical user interface was added to the beginning of the game, allowing the player to choose a character from three options and to operate in all three storylines (levels): school, home and free time. It was decided that the main themes of the game would be relationships, intoxicating substances, economic skills, mental health, and daily life activities. The background to all the storylines was taken from the "role map of a young person in the process of becoming independent" (Fig. 1). During the story, the player would be able to make decisions by choosing from several options. At the end of each level, the player would be able to find additional

information through external links related to the themes of the story.

The aim of the game was to evoke new thoughts and ways of thinking concerning daily-life decision making and problem-solving situations. The players would face the consequences of the choices they made during the game.

Figure 4: New characters and colours.

The programming and tools used remained the same, but there was a major change to the graphics in this second phase. The art style used darker colours and more robust characters, as presented in Figure 4. This changed the whole atmosphere, thus making it possible for a player to empathise with the characters. In addition, the stories in *GoML* took on a new, more realistic approach with a twist of darker shades: all the characters had problematic backgrounds. It was felt that the narrative's collective assimilation would be deeper if the players could find a means of identification with the characters. Deeper character descriptions were used and difficult issues in the storyline were dealt with in order to evoke feelings in the players, thus making the game more immersive and effective.

3.4.1 Evaluation of *GoML*

The second version of *GoML* was tested in several ways. It had already been under constant testing through its availability on the website (www.elamanipeli.com). At the end of the game, there was a request to fill in a feedback form. This brought only very general comments about the game.

In a qualitative study, nine young people (aged 18–22 years) who had some problems with life management skills were interviewed after playing *GoML*. According to the results, the interviewees recognised different themes in *GoML* and openly began to describe how they would act in similar situations. *GoML provoked discussion about very difficult areas of life management* such as lack of sleep, problems at school and problems with substance abuse. The study also showed that young people as players tended to make decisions in the game to see what might happen, often even *making opposite decisions from what they would do in life*. The interviewees brought up the need for more choices that were not so obvious. The study thus showed that *GoML* works as a discussion tool between professionals and patients in nursing or youth work: communication is easier when the discussion concerns a third party (a game character).

The mental health professionals who participated in the development process were provided with a protocol on how to use *GoML* as a discussion tool in their work with young people.

4 DISCUSSION

The objective was to identify the key phases in designing and developing SG and to study how serious game design takes into account affective computing. Starting from serious games development theory and based on previous literature about digital serious games, especially visual novels and health games, we used and further developed this knowledge in a case study by creating a new serious game.

The game developed, *GoML*, can be used in mental health work, social welfare work and youth work as a tool for an adult and a young person to evoke conversation and thoughts about life management issues. It aims to help young adults to reflect on their attitudes, thoughts and behaviour concerning such issues.

We suggest that the *analysis* is one of the key phases in designing and developing a health game. It is essential to involve different stakeholders (such as experts in the field) and end users (patients) as early as possible in the game development process. A good collaboration and an effective understanding of user needs play a key role in finding the right triggers for raising the emotions of players, thus leading to an effective outcome.

In addition, a good *concept* for the health game helps in the communication with different stakeholders. An *iterative development* of a demo version can be used as a proof of concept and *tested* with end users. A visual novel style and well-designed narrative can help players relate to the characters, thus influencing their emotions.

The results support the previous work of Braad et al. (2013), Friess et al. (2014) and Deen et al. (2014) showing the importance of a strong research and analysis phase at the beginning and emphasising that a good understanding between the different stakeholders is essential in serious game development. The key phases of this study also follow the guidelines for serious games development set by Brox et al. (2011).

We agree with Yannakakis and Togelius (2011) who state that games can offer emotional experiences and thus be good examples of affective computing. We argue that serious games in the health sector follow Picard's (2011) basic definition of affective computing. However, based on the understanding of player motivation provided by Rigby and Ryan (2011) and Malone and Lepper (1987), we would offer the following definition: *Serious game design aims to influence intrinsically motivating factors in order to deliberately influence emotions*.

5 CONCLUSIONS

The key phases of the design and development of SG are based on a profound analysis and good understanding of the aim and players of the game being developed. It is thus important to design characters and narratives that players can assimilate. Iterative development and various testing methods make it possible to check during the development whether the serious game is working as planned. SG design takes into account affective computing by nature: game design deliberately influences emotions in order to engage players.

As a narrative-intensive visual novel, it was possible to include in *GoML* different viewpoints regarding life management issues. The "role map of a young person in the process of becoming independent" provided a sound theoretical background for the storylines. *GoML* can be used in nursing or youth work as a discussion tool to evoke conversation and thoughts between professionals and patients, and the game comes with a protocol for its use.

We are continuing our research on the development of serious games in the health sector. The thorough evaluation and validation of *GoML* needs to continue further. Identifying the key phases of designing and developing successful SG continues with other case studies. We also suggest that future research into serious games should take into account new platforms such as virtual reality that will move affective computing to the next level.

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