Designing a Serious Game for General Practice Management

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ABSTRACT
General practitioners (GPs) have to professionally manage their practice. Studies on the quality of GP educational programs revealed that the majority of GP students are dissatisfied with what they learn about running an own general practice. They learn mostly theory from textbooks as opposed to hands-on experience. The new-generation GPs are raised digitally and need more modern learning methods. In this paper, we study the use of serious games to bridge this educational gap. First, we present the RIDEVA serious game design framework that expands existing literature and stresses the importance of mapping intended learning outcomes into formal and dramatic game elements. Second, we develop a prototype game for general practice management in the Dutch context to demonstrate and evaluate our design framework. The results obtained indicate that our serious game design has potential to bridge the educational gap, but also show room for improvement.

Keywords
Serious games, serious game design, general practice management, healthcare, learning

INTRODUCTION
The healthcare sector is a stakeholder-rich environment in which quality assurance aspects are increasingly regulated, thereby creating growing pressure on healthcare providers (NVZD 2015; Rijksoverheid 2015). Healthcare professionals have to manage their organization at the same professional level as they perform their medical profession (Raad voor de Volksgezondheid en Zorg 2013). The general practitioner (GP) domain is a key example of healthcare professionals running their own organization (NIVEL 2015a).

Studies on the quality of GP educational programs in the Netherlands revealed that the majority of GPs in training and alumni are dissatisfied with what they learn about GP management (Heiligers et al. 2014; van der Velden and Batenburg 2011; van der Velden et al. 2005). Their knowledge is mostly from textbooks and is hard to apply without hands-on experience. The new generation of students are raised with computers and have a different learning attitude and preferences (Oblinger 2004). Traditional learning methods do not fit this new generation; flexible, interactive and participative methods are

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needed to improve the situation (Prensky 2007). This triggers the problem statement of this research: "*GP students increasingly need to learn general practice management in an engaging manner that better suits the digital native generation*."

An emerging approach for training professionals in managerial skills is to use serious games (Crookall 2010). These games focus on developing educational or career-related knowledge and skills, and their focus goes beyond entertainment (Michael and Chen 2005). We argue for serious games as a potential solution for teaching general practice management (GPM) to digital natives and to allow future general practice owners to gain experience on running a general practice by playing a game. Bellotti et al. (2013) have presented empirical evidence showing the potential of serious games for learning: the students who learn using games can achieve higher test results than those who learn via traditional learning methods. Serious games allow players to make decisions on risky and complex situations in a safe environment (Squire and Jenkins 2003). Moreover, they are useful when real-life training would be expensive and time-consuming (Corti 2006).

Unfortunately, it is too often the case in serious games design that (educational) content is poured into the games in an ad hoc manner, assuming that playing a game unquestionably motivates players to learn (Gunter et al. 2006). This creates games that are not conductive to learning and do not meet their intended learning outcomes (ILOs). Thus, Gunter et al. (2006) argue that a formal paradigm is needed to design effective serious games that are educationally sound and use well-established game design principles to engage players.

In this paper, we study the use of serious games to overcome these limitations in the context of general practice management education. We make the following contributions:

- We propose the RIDEVA serious game design framework (Requirements Identification, game Design & EVAluation) that builds and expands on literature to overcome the limitations of existing approaches.
- We introduce the *General Practice Manager* game by describing its design that applies our proposed RIDEVA framework.
- We report on an initial evaluation with experts in the GP domain, which aims to assess the quality of the proposed serious game design.

The rest of the paper is structured as follows. We discuss related work on serious game design. We present our proposed serious game design framework. We define the intended learning outcomes for general practice management education. We explain how we applied the three phases of our design framework: requirements identification, design and development, and evaluation. We conclude with a discussion and future directions.

RELATED WORK

We review related work in serious game design and managerial games in healthcare.

Serious Game Design Frameworks

The Design, Play and Experience (DPE) framework (Winn 2008) builds on the Mechanics-Dynamics-Aesthetics (MDA) framework (Hunicke et al. 2004) and provides an iterative process to design serious games. DPE consists of three aspects, i.e., Design, Play and Experience that are combined with five layers: learning, storytelling, gameplay and user experience elements, which are supported by technology. Besides a process, DPE can also be used to study serious game design by following a systematic approach.

The Game-Based Learning (GBL) framework (Freitas and Staalduinen 2011) consists of a four-dimensional framework with three columns (learning, instruction and assessment) that provide overlapping game design elements. The learning column defines the purpose and objectives for the serious game. The instruction column facilitates knowledge transition through an instructional design using a learning cycle that aligns with the player. The assessment column provides the player with feedback during and after the playing the serious game, leading to learning outcomes.

The Serious Game Design Assessment (SGDA) framework (Mitgutsch and Alvarado 2012) consist of six serious game design elements: purpose, content/information, game mechanics, fiction/narrative, aesthetics/graphics and framing. The purpose of the game should be fulfilled by the proper choice of coherent design elements.

Aleven et al. (2010) present a design framework for educational games that includes three components: learning objectives, the MDA framework, and instructional principles. The learning objectives should be identified early in the design and match the knowledge level of the target audience. The game designer needs to design mechanics based on the learning objectives, which have effect on dynamics and aesthetics. The instructional principles facilitate the learning process, which should be research-based and contribute to a coherent story. Although aligned with our work, this approach is too coarse-grained.

LEGADEE is a model-driven approach for learning games and is supported by an online collaboration tool (Marfisi-Schottman 2012). This tool provides a method and toolbars that are adapted to the role of the participant (teachers, game designers, etc.) in the design process. LEGADEE also provides a model for creating an innovative Learning Game scenario, which allows the educational structure of the pedagogical expert to be integrated with the scenario of the game designer.

Huynh-kim-bang et al. (2010) analyzed 20 serious games and derived design patterns that are based on engagement (fun), instructive interaction and acquisition of knowledge/skills. These serious game design patterns focus on reusable solutions to frequently occurring problems for a specific context rather than game design elements. The design patterns are divided amongst six categories that help answer a design problem when attempting to encode instruction and/or fun into a serious game. The authors state that educational objectives should be formulated before using the patterns.

Tang and Hanneghan (2008) propose a domain-specific modeling language derived from existing software modeling languages. The framework allows modelling for data and visual modelling. The data model describes the objects, flow and processes. The visual model describes the positioning of the components within the game. This approach focuses mostly on technical aspects and does not take assessment aspects into account.

We argue that each approach provides a different point of view to serious game design and that no single approach covers all aspects. Moreover, the existing serious game design approaches are abstract, not holistic and do not provide concrete elements to design serious games. This calls for a revised framework that combines the findings.

Managerial Games in the Healthcare Sector

Heartbeat is an offline serious game in which players are working at the Heartbeat Medical Center (MC) and is meant to create awareness on how a hospital operates (Q-Academy 2015). Players have the common goal to turn the Heartbeat MC into a

successful hospital and targets managers, medical specialists and nurses. Heartbeat simulates processes in which players experience and learn how to deal with challenges that the Heartbeat MC faces on a daily basis, such as optimizing the primary process, gain control over the administrative processes and coping proactively with stakeholders. Our aim, however, is to develop a digital serious game, and to focus on the GPM domain.

The HAN-healthcare serious game aims to create awareness on how integrated care is conducted in an hospital, while teaching the required knowledge and skills (Bogers et al. 2014). Players adopt different roles but with the common goal to successfully organize clinical pathways and guide patients through the hospital departments. This is also an offline game. Its evaluation showed that players had an increased learning effect, found the serious game useful and more engaging than traditional methods.

The game eMedOffice focuses on teaching GPs about the optimization of interior design, equipment and workflows of a general practice by creating a problem-based learning environment (Hannig et al. 2012). The goal of the game is to learn to react to problems from staff and patients that are caused by suboptimal arrangements. Players perceived the game useful and considered it high quality, while an increased learning effect was measured. Our focus, however, is not on the optimization of the layout of a practice.

PROPOSED SERIOUS GAME DESIGN FRAMEWORK

We propose a serious game design framework called RIDEVA (*Requirements Identification, game Design & EVAluation)* that combines existing approaches and that we employ to design our serious game the *General Practice Manager*. Our aim is to provide a structured serious game design approach that is holistic and provides designers with concrete elements. Our proposed framework (Figure 1) consists of three key phases: requirements identification, game design and the evaluation. These phases are detailed in the following subsections.

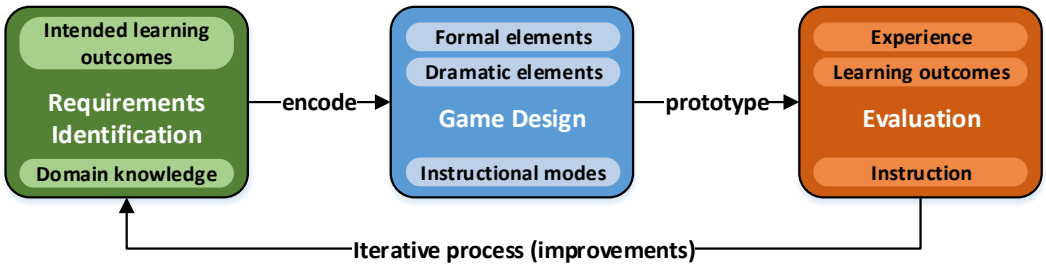

Figure 1: The RIDEVA framework for serious game design.

Requirements Identification

The first phase of our framework concerns the identification of the requirements for the serious game. In line with the common advice of existing approaches, which postulate that the design should start with what the player should learn, we propose to do this by defining the *intended learning outcomes* of the game, which the player is expected to achieve. Bloom's taxonomy is a frequently used approach to describe intended learning outcomes and provides a ready-made structure as well as a list of verbs. The taxonomy categorizes the cognitive (knowledge), affective (attitude) and psychomotor (skills) domain; the cognitive domain is used the most for writing learning outcomes.

Anderson et al. (2001) redefine the cognitive (knowledge) domain of Bloom's taxonomy as the intersection of two dimensions, i.e., the cognitive process and knowledge dimension to improve usability. The cognitive process dimension presents an increasing cognitive complexity, ranging from remembering to creating. The knowledge dimension contains four types of knowledge, ranging from factual (concrete) to metacognitive (abstract). The intended learning outcomes should be stated with a verb (action) that refers to the intended cognitive process and an object (noun) that refers to the knowledge that is expected to be acquired or constructed. An example of a well-defined intended learning outcome is: "*Students should be able to examine a patient extra-orally or intra-orally*". Moreover, *domain knowledge* is essential to complement the requirements and to obtain a more adequate serious game design. In the case described in this paper, this corresponds to GPM in the Dutch context.

Game Design

The intended learning outcomes and the domain knowledge are then encoded into a serious game design, which consist of game elements and instructional modes. The frameworks described in the previous section do not rely on a precise list of game elements. Moreover, the game elements they consider are open for interpretation and combining them may lead to contradiction. Therefore, we choose the formal and dramatic game elements from the Fullerton's *Game Design Workshop* book (Fullerton 2008)" as a guideline. The formal elements describe and form the structure of the game, creating the game experience. The dramatic elements provide context to the gameplay, integrate the formal elements and create emotional engagement for the players.

The *formal elements* that define the structure of a game are players, objectives, procedures, rules, resources, conflicts, boundaries, and outcomes. To get players excited to play, an engaging *invitation* should be created. The *number of players* and different *roles* that the players can adopt in the game should be described. The *player interaction patterns* characterize the interaction between player, game, and potentially other players.

The *objectives* define what the player should strive for within the rules of the game. Objectives should be challenging yet achievable and can be used to set the tone of the game. The *procedures* are the actions and the play methods that players can do to accomplish the game objectives. A procedure defines who can use it, what the players can do when the procedure occurs, when they take place, and how players access them. The *rules* define the actions that allowed for the players and the game objectives. The game designer should describe how the players learn the rules and how they are defined.

Resources are assets that can be used to achieve specific goals. The designer's job is to determine how and when a player can access resources. The resources have to be useful for the game, while they also have to be scarce to challenge the player. When players try to achieve goals within the rules and boundaries of the game, *conflict* develops. Conflict can be created by rules, procedures or situations that disallow players to achieve goals and can create competition. *Boundaries* are used to separate the game from elements outside the game. The *outcomes* of the game must be unpredictable to keep the player engaged. Most games have a win-condition, but other types of outcomes exist.

Dramatic elements make a game emotionally engaging by blending the formal elements into a meaningful experience. They provide context to the game by providing challenge, play, world building and the dramatic arc. Other dramatic elements such as the story, premise and character provide a deeper sense and enrich the player's overall experience.

Challenge is essential to engage a player; to implement it, the *theory of flow* (Csikszentmihalyi 1990) has been used as a guideline. The theory of flow is an uprising path between challenge and ability for tasks that has to stay in balance. If the challenge is too high for a player with a low ability the player will become frustrated, while the player will become bored if they have level of ability and the challenge is too low. *Play* is presented as the freedom of movement within a rigid structure. Bartle (1996) defines different *type of players* to consider when designing a game; for example, competitors aim to beat other players, collectors want to acquire items, and directors want to be in charge. The *premise* defines the action of the game within a setting or a metaphor, making the game less abstract. With a good premise, a backstory is not necessary.

In a game, the drama is told by the actions of the *characters*. The main character in a game's story is the protagonist that creates the conflict that comprises the story by engaging the problem. Another representation of players in-game are *avatars* that are often created by the player's themselves. These avatars tend to create more empathy as characters are driven by a story. The *story* of the game should be uncertain and the player's job is to resolve this. In most games, the story is an extended version of the premise and is used as a backstory that provides context and a setting. The concept of *world building* is the creation of a fictional world by a deep and complex design such as maps. It may help keep players engaged over time. The *dramatic arc* is the dramatic conflict, which is different than the formal conflict and creates tension in the game. The conflict in the game is considered the most important and can be encountered by the player with obstacles, dilemmas or other players. Implementing a dramatic arc in the game, helps the player come more engaged over time.

Game elements such as the game mechanics are linked to *instructional modes* and are used to describe the instructional design. This describes how the learning process, i.e., knowledge transition is facilitated for the serious game. For our framework, we suggest to employ the design patterns from (Huynh-kim-bang et al. 2010).

Evaluation

The third phase of our framework evaluates the serious game, which requires transferring the serious game design into a working prototype**,** so that players can play and experience the serious game. This way, the designer can determine the extent to which the stated intended learning outcomes match with the actual learning outcomes that the player acquires by playing the game. Moreover, this phase checks if the serious game design from phase two delivers the intended fun and learning experience, and also an adequate learning process through the created instructional design. Multiple evaluation approaches and methods can be used to evaluate serious games. Due to the low maturity of the field, we do not mandate the use of a specific method.

REQUIREMENTS IDENTIFICATION FOR GPM EDUCATION

We describe how we applied our design framework and followed its phases to create a serious game for GPM education. We start with the first phase: requirements identification.

The intended learning outcomes were derived from GPM curricula, literature and a performed interview with an expert. Because our serious game focuses on teaching GPM in the Dutch context, we first analyzed the GPM curriculum of the GP educational program in the Netherlands (Huisartsopleiding Nederland 2014). This study revealed seven main topics, each having its own main intended learning outcome. Then, we

expanded our by reviewing international curricula[1] and by studying scientific literature in the field (Crossland et al. 2014). We did not encounter significant differences, thereby supporting the generality of the ILOs beyond the Dutch context. Finally, in order to refine the ILOs that were too generic, we conducted interviews with experienced GPs who helped us define the following eight ILOs: *A GP should be able to*

ILO1. Analyze the needs of the patient population;
ILO2. Select an adequate set of healthcare services (tasks);
ILO3. Hire suitable staff members;
ILO4. Delegate tasks effectively among staff members;
ILO5. Set out a strategy for the general practice;
ILO6. Understand financial management of a general practice;
ILO7. Respond adequately when internal and external events occur;
ILO8. Understand how managerial decisions influence the general practice.

The intended learning outcomes are rather aligned with the new funding system (Figure 2) for GP care in the Netherlands (which is essential part of the domain knowledge for the game). In the Netherlands, GPs salaries are paid by the insurance companies based on the healthcare services (tasks) they offer to the patients. This new funding system consists of three segments with a different focus (Nederlandse ZorgAutoriteit 2014): Segment 1 focuses basic GP care; Segment 2 is concerned with multidisciplinary care; and Segment 3 deals with rewarding healthcare outcomes and innovation.

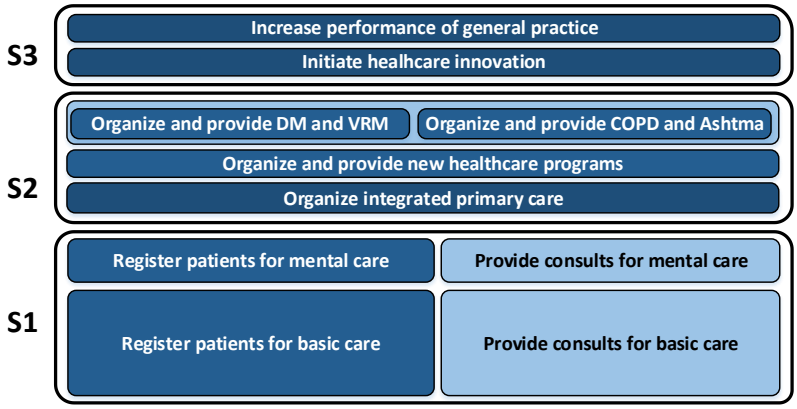

Figure 2: Three-segment model for rewarding GPs based on their offered services.

DESIGN AND IMPLEMENTATION

In the second phase of our framework, the ILOs are encoded into a serious game design. This section shows how we encoded the intended learning outcomes into a justified serious game design, so that the purpose of the serious game can be fulfilled. For every game design decision made, both the intended learning outcomes and game design components from our proposed framework were taken into account. We focus on the dramatic element *story* to illustrate how the game progresses.

Background Information

The purpose of the serious game is to *create awareness of the core managerial business processes of a general practice* by allowing GPs (players) to run and make decisions on their own general practice in a virtual environment. The game provides continuous

feedback on the actions that the players make. This virtual environment implements a micro world interaction (world building) that allows players to shape and revise the general practice as an organization, thereby creating awareness (Huynh-kim-bang et al. 2010). Therefore, the serious game has been called the "*General Practice Manager*".

The target audience of the game are GP students and recently graduates that are interested in starting or taking over a general practice, and aims to mitigate their dissatisfaction with what they learn about running an own general practice (Heiligers et al. 2014; van der Velden and Batenburg 2011; van der Velden et al. 2005). To get the players excited to play our game, an *engaging invitation* has been created as a background story that is displayed after logging in to our serious game. The *background story* tells players that they were going to take over the general practice from their former GP trainer, but could not find an agreement on future direction (*conflict, dramatic arc*). Therefore, the players are going to start a new general practice in a new living area in the Netherlands, where they are allowed set out their own strategy from scratch (*ILO5*).

Structure and Flow

The serious game is divided into four mini-games and is based upon the new funding system for GP care in the Netherlands where GPs are paid by insurance companies and based on the healthcare tasks that they conduct and offer to the patients.

The main objective of the serious game is to deliver population-based healthcare and gradually increases in complexity (*objective*). In mini-game one the player has to organize healthcare for segment one only (basic care), while the player has to deal with both segment one and two in the second mini-game. In the third mini-game, the player has to provide healthcare using all three segments, while having to respond adequately to an internal and/or external event (*ILO7*) in mini-game four (*challenge*). Each mini-game starts with an introduction, followed by the gameplay and ends with algorithmically defined feedback on the decisions made by the player. This allows players convey information without disturbing them and provides a solution for teaching high-level knowledge in our serious game (Huynh-kim-bang et al. 2010).

The player plays versus the game to provide the best population-based healthcare as possible (*players*). Moreover, players compete amongst each other to have the best running general practice (*player interaction patterns*). Providing competition between players with similar skills levels avoids discouragement and motivates the player (Huynh-kim-bang et al. 2010). To achieve the main objective, the player should use the following procedures, which are defined in the following subsections.

Understanding the needs of the patient population (ILO 1)

In each mini-game, the player only receives the necessary patient population data that is required for the segments. The demographics and healthcare characteristics of the Supply, Demand and Analysis Monitor (*Vraag Aanbod Analyse Monitor*, VAAM) are used as patient population data (NIVEL 2015b). The VAAM contributes to the discussion on aligning the supply of primary healthcare to the local healthcare demands of an area. The player is also provided with VAAM data of the municipality and the Netherlands. Providing this data may influence decisions players make for the general practice. An example of patient population data in our serious game is shown in Figure 3.

Figure 3: Example of patient population data.

Providing healthcare tasks/services (ILO 2)

After analyzing the patient population, players should acquire and organize healthcare tasks (services) that align with their patient population. The four largest healthcare insurance companies in the Netherlands offer tasks that a GP can acquire and organize to service the population but with different terms, conditions, and rewards[2].

Task POH-GGZ

General information	
Name	POH-GGZ
Segment	1
Year	2015
Description	The POH-GGZ offers mental health support for the general practice
Terms and conditions	**Staff** * Hire a qualified POH-GGZ * Create plan for POH-GGZ **Resources** * POH-GGZ has an own office * Buy necessary equipment for POH-GGZ * Buy screening instrument software **Other** * Create agreement with other GGZ care provider for consultation * Implement and learn how to use screening instrument software
Application date	Q1, Q2, Q3 and Q4
Contract duration start	2015
Contract duration end	2016
Reward	€ 2.80 - per registered patient € x.xx - depending on type of consult
Reward type	**Consultation rates** € 9,04 - Consult regular shorter than 20 minutes € 18,08 - Consult regular 20 minutes and longer € 13,56 - Visitation regular shorter than 20 minutes € 22,60 - Visitation regular 20 minutes and longer € 4,52 - Telephonic consult € 4,52 - E-mail consult € 9,04 - Group consult

Figure 4: Example of a healthcare task (service).

This has been implemented into our serious game design; to enable a realistic simulation, we require at least four players, one per insurance (*number of players*). To organize healthcare tasks, their requirements shall be fulfilled by carrying out different procedures: assigning actions to staff, managing the hiring of staff, and managing resources. An example of healthcare tasks in our serious game is shown in Figure 4.

Assigning actions (ILO 4)

Important activities in GPM are task differentiation, delegation and reallocation (Dijkers et al. 2011). For example, efficient task delegation may reduce the workload and allow the general practice to provide more healthcare tasks (services). In our game, we allow delegating healthcare tasks to staff members of the general practice. Actions require certain skills that not every staff member of the general practice may possess. Dijkers et al. (2011) define two types of skills in a general practice: medical-technical and managerial skills. These skills have three levels: high, medium and low.

Besides skill, performing actions also takes time. In the GP domain, time is divided into direct patient-related time, indirect patient-related time and non-patient time (Van Hassel et al. 2014). Direct patient-related time is defined as time spent on patients, e.g., performing consults. Indirect patient-related time is concerned with time spent on patients without having contact with them, e.g., medical administration. Non-patient-related time is related to management activities. In our serious game, actions have required skills and time, and staff members are assigned skills. This way, the players can meet the terms and conditions of the healthcare tasks by choosing what staff should do which tasks. An example of actions in our serious game is shown in Figure 5.

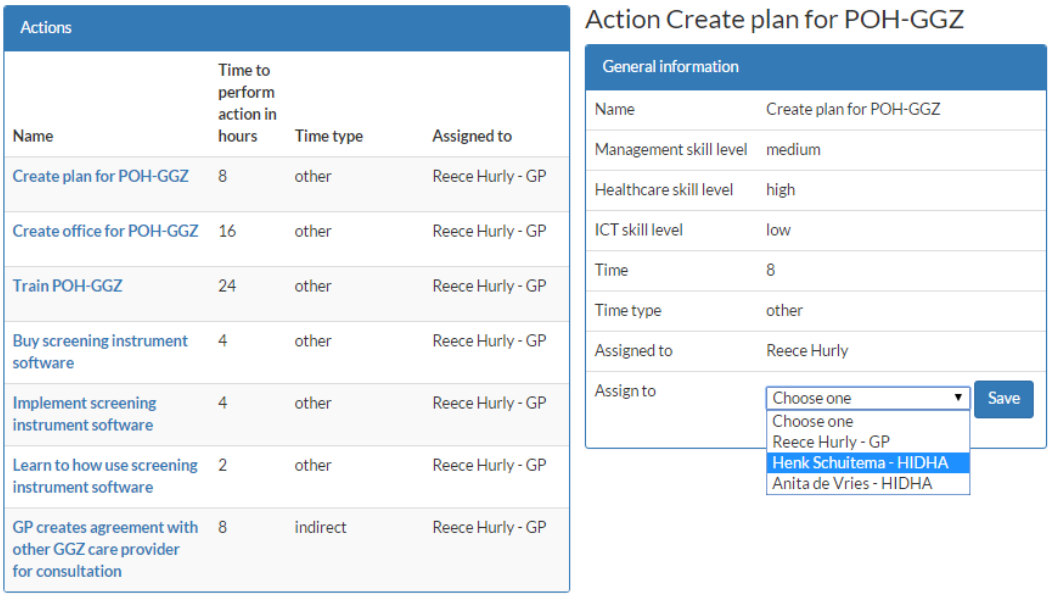

Figure 5: Some actions and their assignment to staff.

Managing staff (ILO 3)

Healthcare tasks require staff members to service the patients of the practice. Since the various tasks require different types of staff members, the player shall hire appropriate staff to deliver the chosen services. Depending on the healthcare task and the number of patients, staff members have to work a certain amount of hours per week for the practice to have a certain average performance. Players have to determine their own working hours per week and yearly gross salary, which affects the chosen services. If players do not adequately plan their staff capacity, they will incur in a penalty. These hours are also divided into direct patient-related time, indirect patient-related time and non-patient time.

As mentioned earlier, staff members have different skills, also based on their educational level. GPs have the high level, nurse practitioners medium level and assistants the lowest level. Staff members also have other attributes that contribute to creating a more immersive experience, such as name and gender. Other attributes play a role in delivering population-based healthcare, such as specialization and nationality. For example, if the demographics of the player's show a larger number of elderly, the player should hire a GP specialized in elderly care.

In our serious game, players can hire and fire staff members that align with the acquired healthcare tasks. For hiring, a job market screen shows potential candidates. If one player hires a staff member, the vacancy disappears from the job market screen for other players (*rule*, *conflict*). This depicts the scarcity of available healthcare professionals, which is common in reality especially as far as doctor assistants (DAs) are concerned (Expert 2, personal communication, July 22, 2015). Hired staff members cannot be fired in the same mini-game. An example of staff members in our serious game is shown in Figure 6.

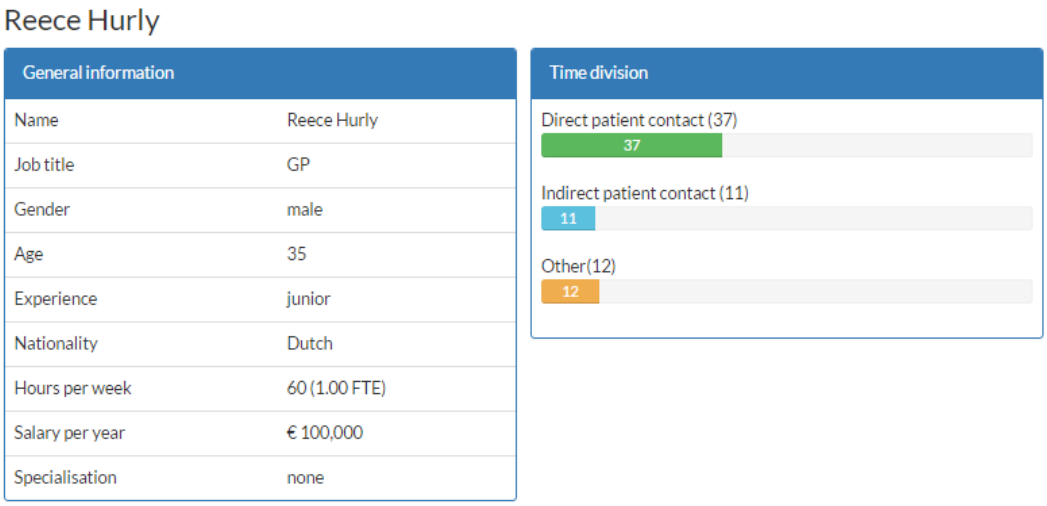

Figure 6: A staff member and its time division.

Managing resources

Healthcare tasks also require resources to provide services to the patient population. For example, software is needed to support the administration process, and medical equipment is required to perform medical procedures. In our serious game, players can buy and sell resources for the acquired healthcare tasks.

Feedback

Every mini-game is played until a timer expires or the players press the "Finish turn" button. Upon mini-game completion, players receive qualitative and quantitative feedback on their decisions made during the game (*outcome*). The feedback mechanics should create awareness on the managerial decisions a GP has to make and the effects of these decisions (*ILO 8*). The feedback is based on five KPIs (personal communication from an experienced GP trainer, 16 April 2015) and the outcomes depend on the decisions that players make in our serious game; the KPIs are the following:

- Cost reduction for the ecosystem: the general practice, the patients, and the government; for example, cost reduction is achieved if the GP provides basic mental healthcare rather than always referring patients to specialists.
- Alignment with the needs of the population; for example, alignment exists if a certain language is predominantly spoken in the player's area, and at least one staff member that speaks that language is hired.
- Patients perception of care and services, determined by the amount of hours that staff members devote to patients care. If staff capacity is not properly planned, the waiting times for consults will increase and patient satisfaction will decrease.
- Employee perception of working in the practice, dependent on the types of tasks that are assigned to staff members. For example, if too many managerial tasks are assigned to medical staff, their satisfaction will decrease.
- Financial health of the general practice (*ILO 6*), determined by the difference between income and expenses of the general practice. Income originates from the provided services, which are reimbursed by the insurance companies. Expenses include salaries of staff members and costs for housing/ICT, etc.

An example of feedback in our serious game is shown in Figure 7.

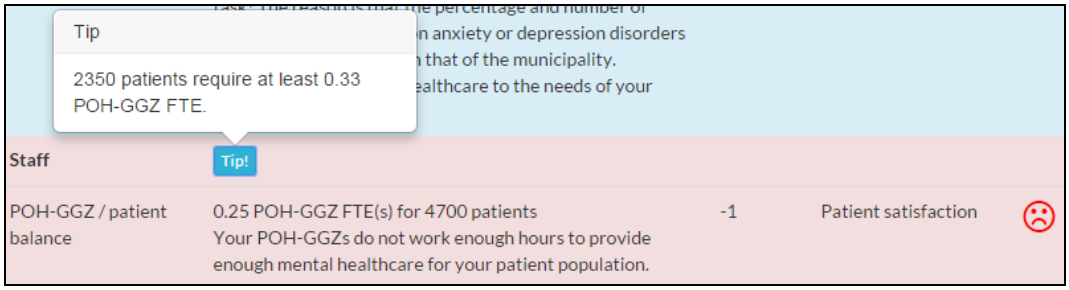

Figure 7: Example of feedback on patient satisfaction

EVALUATION

The third phase of our proposed framework is the evaluation. We describe the approach used to evaluate our serious game design and the obtained results. We have used the DECIDE framework proposed by Rogers et al. (2007) to describe our evaluation approach. The framework provided us with guidelines, has been widely cited and is based on solid literature, which allowed us to make informed decisions on our approach.

The DECIDE framework consists of six stages, in which the first stage determines the overall goals that the evaluation addresses. The second stage explores the specific questions that have to be answered and are based on the previously mentioned evaluation goals. In the third stage, the evaluation paradigm and techniques are chosen to answer the questions. The fourth stage identifies practical issues to address, such as the selection of participants. In the fifth stage ethical issues are dealt with. The final and sixth stage is the evaluation itself, moreover, the interpretation and presentation of the data.

The evaluation focused on determining if our intended learning outcomes and serious game design align with teaching general practice management in the Dutch context. This also allowed us learn lessons that can be used for the next version of the game. We conducted our evaluation through two focus group sessions and four individual interviews (questions available in our online appendix[3]) with experts in the GP domain.

The focus group was presented with specific parts of the serious game design and open questions were asked on the instructional design. For example, we asked the focus group about our designed start scenario and game mechanics such as the hiring process for staff members. We also asked detailed questions on our feedback mechanics. The individual interviews included a questionnaire and the 100-dollar test to evaluate the adequacy of the intended learning outcomes and KPIs. Moreover, a Cognitive walkthrough for Learning Through Game Mechanics (Farrell and Moffat 2013) and questionnaire was used to evaluate some of the game mechanics. The obtained results from the evaluations were fairly positive and are described per evaluation goal in the following subsections.

Intended Learning Outcomes

We have evaluated the intended learning outcomes through individual expert interviews with four experts. We asked experts to state the three most important intended learning outcomes for GPM, taking into account the target audience. Afterwards, we showed them the intended learning outcomes we stated for our serious game and asked to rate them using the 100-dollar test. Finally, some experts also provided additional comments.

The interviewees suggested that devising a strategy for the general practice should be the main learning outcome of the game. This has been implemented only partially; however, the experts mentioned that the player should be allowed to specify an "ideal" plan/strategy for the general practice, and that the feedback of the game should be based on the extent to which the player meets the ideal plan. Delegating tasks to staff members and hiring adequate staff members were also stated as important, which covers a large part of our serious game. Selecting an adequate set of healthcare tasks has not considered as very important; however, our opinion is that this happened because not all experts were very familiar with the new funding model for GP care yet. Therefore, we suggest that this ILO should not be changed, for GPs should learn to make strategic choices for the general practice based on this new funding model.

Analyzing the needs of the patient population was considered as average: most experts thought staff members know their patients well. Our opinion is that this is still important in the game to explain that all decisions should be based on the patient population. Responding adequately when internal and external events occur were not considered positively. Most experts thought that understanding how managerial decisions influence the general practice was a given fact and the purpose of the game; this may be the reason for the not-so-positive evaluation.

Serious Game Design

We evaluated the serious game design with both the focus group and individual expert interviews. We asked the focus group open questions on the instructional design, such as whether the hiring staff mechanic had been translated adequately. We also asked about the adequacy of the KPIs and of our feedback mechanics. For the individual expert interviews, we adopted the same protocol described in the previous subsection.

Experts mentioned that they liked the *game concept* and find the *flow* adequate. However, they suggested that we should be changing the serious game design for the start scenario. Both evaluation have shown that both the green-field and brown-field (take over a practice) scenario should be offered to the players. This could be done by creating multiple scenarios for the game, where players can choose from. This way, players can play and learn from both types of scenarios. The green-field scenario could stay the same, while the brown-field scenario should include taking over staff members and financial

situation from the previous general practice owner. The experts indicated that providing patient population data from the VAAM by the virtual HIS as presented in our serious game seems adequate. However, we should consider providing more information, such as the number of consults that are performed by the general practice per health issue. Experts mentioned that this may stimulate for better decision making by players, when selecting and organizing adequate healthcare tasks and managing staff.

The adequacy of the hiring process of staff members depends on demographic data such as nationality. However, the experts stated that matching personalities to ensure that staff members fit the current team is more important. In our opinion, this is extremely difficult to encode without making the game too complicated. The current game mechanic for delegating actions (using skill-levels) were considered as adequate. While the experts have also provided us with other criteria (e.g., SWOT analysis), they seem difficult to transfer to a game while keeping it fun. Allowing players to determine their own working hours and salary was rated as useful by the experts. However, the details of the process should be clarified to avoid confusing the player and to make the process more realistic.

Concerning the KPIs, the interviewees judged patient satisfaction, employee satisfaction and financial health as the most important ones. They suggested to remove the reduction of the cost per capita as a KPI and explain this just as background information. Moreover, healthcare alignment could potentially be merged with patient satisfaction. Among the suggested improvements, the experts proposed to include the company type of the general practice into the financial balance, as it influences how the income and/or costs of the general practice are divided. The feedback that the game provides regarding the hours that GPs and DAs work was deemed as adequate. The use of an algorithm to determine the KPIs was evaluated positively. The fine-tuning of the feedback mechanics is expected to contribute to the realism and effectiveness of the game.

DISCUSSION

In this paper, we proposed a serious game design framework that we used to design the *General Practice Manager* game. Our goal was to study the use of serious games to bridge the educational gap between the current educational practices and the digital natives' preferences and attitude in the context of general practice management.

The evaluation with domain experts focused on the intended learning outcomes and the game design. The results show alignment with teaching GPM in the Dutch context, but also room for improvement. Our game was found suitable for the target audience by providing a safe virtual environment for young doctors to experiment managerial skills. The experts were enthusiastic about the concept and found the flow with increasing complexity adequate. They also recommended that realism should be enhanced.

Our evaluation has some limitations. Although it relies on scientific literature, the design framework has not been validated. Documents, literature and interviews are translated from Dutch into English, and some information could have been lost or misinterpreted. Only a few intended learning outcomes were used for our serious game and these have been chosen by the researchers. The actual target audience could not be involved in the evaluation; the results are only based on the opinion of GP trainers and experts in the field: we estimated their level of knowledge but did not measure it beforehand. We also did not measure the engagement (entertainment value) of our serious game design yet. Finally, despite our attempt to fully document the complete process, repeating the study is difficult, also due to the increasing acquaintance of GPs with the new funding model.

Additional research is needed to validate our framework. Among the many intended learning outcomes for GPM, we focused on generic processes that apply to every type of organization such as hiring staff members. To determine the effectiveness of the game, the target audience should be involved in the evaluation by letting them play the game and conduct a pre-test/post-test, including the extent to which the implemented game elements are engaging. We have experienced that it is difficult to map certain intended learning outcomes to game objectives and some learning processes to game mechanics in a digital serious gam (e.g., motivating staff members). Thus, future work could explore the use of mixed reality to make the game more realistic and effective.

ENDNOTES

[1] https://drive.google.com/file/d/0B6nXBiTm5rzgZUZfYy1rZXl1bTg/view

[2] https://drive.google.com/file/d/0B6nXBiTm5rzgTWNSbEloZzFHV1E/view

[3] https://drive.google.com/file/d/0B6nXBiTm5rzgTUxrZ1hSOEM5RDA/view

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