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A Multidisciplinary Approach To Serious Game Development In The Health Sector

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A MULTIDISCIPLINARY APPROACH TO SERIOUS GAME DEVELOPMENT IN THE HEALTH SECTOR

*Research full-length paper
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Abstract

Serious games (SGs) provide users with valuable information in a fun, entertaining way. Due to the elements of surprise and simulation, these games potentially engage and inspire their target groups more than traditional methods. Health games are SGs that provide a new model of maintaining and developing mental and physical capabilities for all age groups. The current study focused on the use of SGs in health care.

The research goal was to identify the role of multidisciplinary expertise in developing SGs. Design science research (DSR) techniques were adopted in this study to identify the role of versatile expertise in the health-care context. From the perspective of DSR, this study provides new tools and a method – a rapid prototyping workshop and an SG design canvas – that can help in providing the needed knowledge and in developing ways to communicate these ideas.

In this study, the developed tools and method were applied to six case studies, and lessons learnt were evaluated and tested by participants in the workshop. The proposed SG design canvas also supports a participatory design process and invites users to contribute early in the development process. Overall, this study shows that good health game development can only occur through effective multidisciplinary cooperation.

Keywords: Serious game, health game, game development, multidisciplinary co-operation

1 Introduction

A serious game (SG), or an applied game, is a game whose main purpose is something other than pure entertainment (Djaouti et al., 2011; Susi et al., 2007; Zyda, 2005). These games can be used to either change a player's behaviour or to motivate them in a particular way (Baranowski et al., 2013; Ryan et al., 2006).

Health games are one form of SGs that seek to positively impact human learning, health and well-being. These games can be used to support a person's psychological, physical and social well-being, and they can be played alone or as a form of interaction between a customer/patient and health-care representative. Health games utilise game elements like surprise and feelings of reality to inspire and engage users. For example, convalescence and rehabilitation can be made more pleasant through the virtual world of a game, and thus health games can provide new methods for self-help or rehabilitation (Kempainen et al., 2014.)

Health game development is motivated by the need to support professionals or patients, and game design experts, health-care professionals and end users all participate in developing the game concept. The game implementation process includes design, production, graphics, programming, sound and testing, and health-care experts provide support through their professional knowledge. Due to the many different potential applications of SGs (see, e.g., Kempainen et al., 2014; Ricciardi & De Paolis, 2014; Zyda, 2005), their development requires the involvement of experts from a variety of disciplines. In this study, our research goal was to identify the role of multidisciplinary expertise in developing SGs. The results are presented in the form of a framework, i.e., a special canvas designed for game design.

The main research question in this study was:

What kind of tools and methods can help a multidisciplinary team work together when developing health games?

The term *multidisciplinary expertise* refers to the gathering of professionals from multiple academic disciplines to collaboratively solve a defined problem (Nancarrow et al., 2013). Game development requires a team of experts with different backgrounds, and the development of SGs also requires the participation of professionals in the target content area (Kempainen et al., 2014).

Design science research (DSR) techniques were adopted in this study to identify the role of versatile expertise in the health-care context. The framework introduced by Hevner et al. (2004) was applied in the study, the literature review provided background and the development of a series of SGs in the health sector produced context-dependent information and new knowledge upon which to build the framework. Next, relevant tools and methods were developed and piloted. The findings from this study can increase the current understanding of how to best utilise multidisciplinary teams in health game development and provide new tools for this process, such as a canvas and workshops for implementation.

This paper describes the multidisciplinary development of SGs at Kajaani University of Applied Sciences (KAMK), Finland, and is organised into five major sections. Following this introduction, the next section reviews the related work. Section three presents the research methodology, followed by the results, evaluation and conclusion.

2 Related Work

This chapter summarises previous studies related to the topic of SGs in the health-care environment.

2.1 Serious Games in Health Care

The concept of SGs was introduced in the 1970s, when it referred to an activity among two or more independent decision-makers seeking objectives in a limited context. At that time, SGs were primarily focused on educational functions (Ricciardi & De Paolis, 2014). They were usually digital games whose main purpose was something other than pure entertainment; i.e., they were designed to be used for training, education and/or health care (Loh et al., 2015).

Zyda (2005) defined an SG as a mental contest with a computer that follows certain rules or parameters.

The goal is to achieve government or corporate training, education, health, public policy and strategic communication objectives through entertainment (Zyda, 2005). Susi et al. defined SGs as games “that engage the user and contribute to the achievement of a defined purpose other than pure entertainment (whether or not the user is consciously aware of it)” (2007, p. 5).

The health-care sector has strong interests in using new technologies related to health (Haux, 2010; Moen et al., 2012; Arnab et al., 2013). Today’s increasing health-related challenges due to the aging population and increase in chronic diseases suggest that SGs may be one strategy to improve health-related outcomes in the current and future generations (Arnab et al., 2013).

SGs in the health sector can be divided into game-based education of health professionals and game-based improvement of the therapeutic outcomes of patients (Arnab et al., 2013). Health games can also be classified by their main purpose, type of players and stage of disease of the patient (Wattanasoontorn et al., 2014). Wattanasoontorn et al. (2014) indicated three main purposes for health games:

1. Games that are designed originally for entertainment and in which a health purpose is present but is a secondary focus
2. Games that include a health topic with the goal of passing on knowledge or skills
3. Training games with a medical purpose, including simulations.

According a systematic mapping study by Korhonen and Halonen (2017b), the top five SG subjects in health care are education, exergaming, cognitive rehabilitation, psychology and physical rehabilitation. The primary target groups of the SGs described in this mapping study were children, the elderly and patients with certain diseases.

There are many different stakeholders in the health-game market, such as hospitals, clinics, private-practice physicians, government, corporations, other organizations and individual consumers (Susi et al., 2007). Social security systems and health-care providers differ significantly by country, and on a global scale each market has its own methods for facilitating a healthy lifestyle (Kaleva et al., 2013). In the near future, significant changes should be expected in relation to medical simulations, SGs and mobile SGs, and an increased need for SG analysis is already present (Loh et al., 2015).

SGs offer customers of different ages a new and entertaining approach to increasing their health and well-being, and the intended impact and needs of the target group must be considered during the development of these games. Suitable business models should be explored at the earliest possible stage so that all requirements can be considered during game development. The development of a health game requires multidisciplinary and smooth cooperation (Kemppainen et al., 2014).

2.2 Multidisciplinary Expertise in SG Development

The terms *multidisciplinary teamwork* and a *collaborative or participatory design process* actually refer to the same phenomena, just from different angles. Software game development is a multidisciplinary activity, where team configuration and management are a big challenge. Game development teams have quite different types of people working on them, from computer scientists to illustrators and business managers, and several factors have been identified that have an effect on successful collaborations among such diverse groups. There are interpersonal factors, such as trust between team members and communication skills, willingness to collaborate and mutual respect, as well as organizational factors, such as having suitable protocols and supporting collaboration (Aleem et al., 2016; Fullerton et al., 2008).

Tran and Biddle (2008) described three main factors that contribute positively to the collaborative process in SG development: respecting others’ roles, participating in iterative development and having a shared vision for the game product. Other factors mentioned were a collaborative spirit and a supportive technical environment.

A *participatory design process* is a design approach in which the users participate in and oversee the making of design decisions through the entire design process (Gulliksen et al., 1999). Here, the users

are one of the many actors involved in the participatory design process (other actors include designers and other experts). Participation in this sense is meant to improve the design process so that a meaningful game is developed (Lukosch et al., 2012).

When designing SGs in the health sector, the target group needs to be considered during the development process (Braad et al., 2013; Brox et al., 2011; Friess et al., 2014; Deen et al., 2014). A multi-disciplinary team is necessary to develop a successful and effective health game, and professional knowledge is an essential part of this development process (Kempainen et al., 2014; Merry et al., 2012).

It is important to define both the target group and main objective and then design a game using existing game design principles in collaboration with health professionals, involving patients as early as possible (Brox et al., 2011). Braad et al. (2013) described the health game design process as a game-based intervention process. Their human-centred design method consists of four phases: analysis, design, development and evaluation.

Like Braad et al. (2013), Friess, Kolas and Knoch (2014) and Deen et al. (2014) used similar processes in SG development in the health sector. They all included strong research and analysis phases at the beginning, and they agreed that involving different stakeholders is essential. Iterative development processes and the use of prototyping are some of their development methods. The game development process then usually ends with user group testing and evaluation or validation phases.

Korhonen and Halonen (2017a) suggested that analysis is one of the key phases when designing and developing a health game and that it is essential to involve different stakeholders as early as possible in the game development process (see Fig. 1). A working collaboration and an effective understanding of user needs play key roles in obtaining an effective outcome. In addition, having a clear concept of the health game helps when communicating the vision with different stakeholders, and an iterative development of a demo version can be used as a proof of concept and can be tested with end users (Korhonen & Halonen, 2017a).

GoML – STAGES

Iterative development process

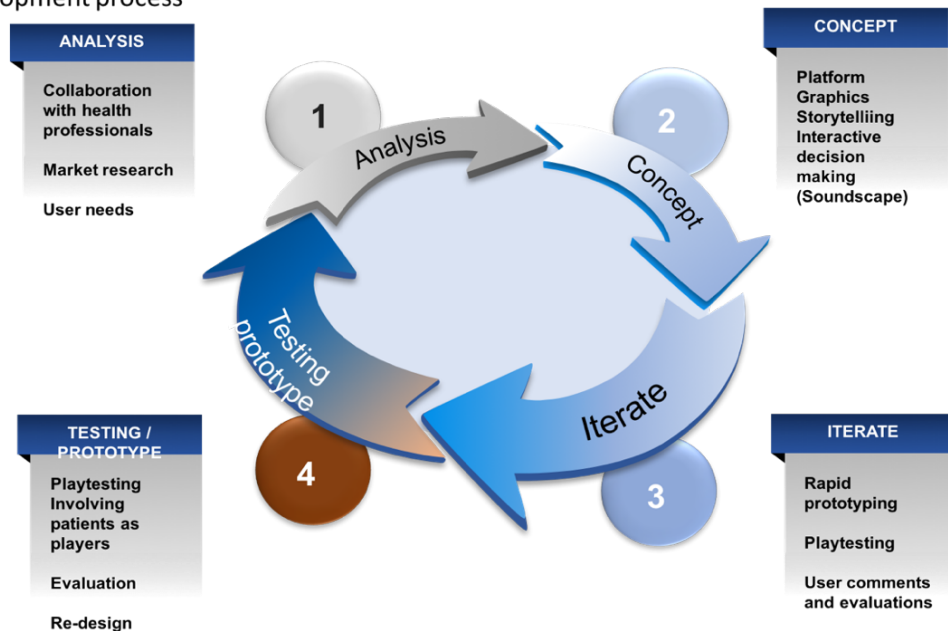


Figure 1. The iterative SG development process (Korhonen & Halonen, 2017a).

2.3 Tools and Methods for Multidisciplinary Teamwork

Lukosch et al. (2012) described using computer-mediated brainstorming sessions for the participatory design of their simulation game. They then role played scenarios, conducting interviews with experts in the field and a review of literature on SGs regarding the subject area. Kayali et al. (2015) used design workshops as participatory game design method for the development of a health game for children with cancer. They concluded that user-centred and participatory design methods are helpful in the early stages of a project as they provide a general direction for the design. In a play-centric design, the key point is that ideas are prototyped and play-tested early, so a playable version of the game idea is needed immediately after brainstorming ideas (Fullerton et al., 2008).

Carey (2017) introduced a game design canvas inspired by a business model canvas for the game design phase. This canvas works as a tool to quickly combine the design thinking with a user-centric approach. The canvas guides the game designers to start thinking about the players and the intention of the game, then progressing to game design elements and finally to other considerations, such as development and marketing. This game design canvas was developed for professional game designers and is supported by game design workshops (Carey, 2017).

Zavcer et al. (2014) developed the Serious Games Design Pattern Canvas to assist in a bottom-up approach to designing SGs. This canvas gathers together information about related research, the purpose, key data, mechanics, channels and users into the visual form of a canvas.

3 Research Methodology

Systems development from the research domain point of view as described by Nunamaker and Chen (1990) offers a fruitful base for seeking for new solutions to an identified problem. They listed eight ways to find these solutions: 1) build a system, 2) construct a method, 3) develop a theory, 4) formulate a concept or a framework, 5) conduct an empirical laboratory test, 6) conduct a real-world test or a survey, 7) describe a case and 8) declare the ‘truth’. In this study, to find an answer to the research problem of how to work collaboratively around a defined problem, a DSR approach was used.

This is an established research method that is often used to produce an artefact to solve a real-life problem. Those artefacts can be models, systems, prototypes or other constructs (Hevner et al., 2004). Peffers et al. (2008) added that the outputs of DSR can include social innovations and new characteristics of existing technical, social or knowledge-intensive systems. Hevner and Chatterjee (2010) delineated DSR as a research method that focuses on problems related to human beings and that develops innovative artefacts and promotes new knowledge in a particular discipline. They especially noted that the developed artefacts should be functional and useful in their contexts and should help people solve problems.

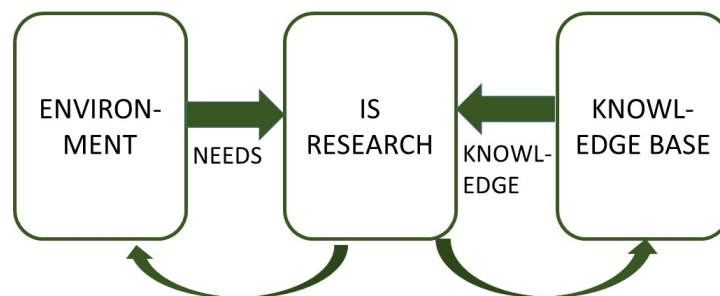


Figure 2. Design science research approach (Hevner et al., 2004).

Figure 2 describes the research approach as introduced by Hevner et al. (2004). In this study, the environment consisted of people coming from several disciplines such as health care, education, and

software design. Knowledge base included existing knowledge containing gaming studies, education science and healthcare. In the current case, IS research was about implementing a solution to help designers and developers to get context-related knowledge and to develop ways how to communicate the emerged ideas. The solution included a rapid prototyping workshop and an SG design canvas, and their implementation is described in Chapters 4 and 5. The implementation required input from the environment and knowledge base, and it required evaluation, iterations and collaboration before the solution was built.

4 Multidisciplinary Expertise in Health Game Development

Since 2009, KAMK has developed several health games in cooperation between the business information technology (BIT, game development), information systems engineering (IS, game technology), and nursing and health-care disciplines. The first SGs developed were a dance game for the elderly and a rehabilitation game for stroke patients. For the dance game, which utilised a dance mat, game development students were responsible for the graphics design and programming. A sports instruction student produced knowledge about the special needs of the elderly for the game design and was responsible for testing the game, the purpose of which was to increase balance, coordination and reaction times. The development process was guided by the students' lecturers in each discipline, and the results were published as their thesis work.

The game prototype for the rehabilitation of stroke patients was also developed by a game development student team in 2011 in close cooperation with patients undergoing rehabilitation and their nursing/care staff. The game used the Kinect game controller, which enabled gameplay using both the hands and feet. It offered a new opportunity to increase the level of difficulty of rehabilitative exercises according to a patient's capability and progress. The level and duration of the exercise and training were dependent on the activeness of the patient. The computer game was found to motivate and inspire the patients to improve performance due to their ability to follow their personal progress and obtain immediate feedback concerning his/her own movements using the game. This health game development process used a very user-driven approach, and, as stated previously, both experts and end users were involved in the design and development phases.

These first development pilot projects were learning processes regarding both SG development and multidisciplinary cooperation. In both cases, the game development team was comprised of BIT students who specialised in game programming and graphics, while the game development process was guided by lecturers. It was noticed, however, that there was a lack of common understanding between different disciplines and that their ways of working differed.

A hired game development team was used for the development of a virtual, game-like training and rehabilitation environment. The environment's games could be controlled via a treadmill, exercise bike or rowing device, using gestures detected by the Kinect camera's sensors or the player's heart rate. The persistent team stayed focused on the work and built a knowledge base for future projects. Several companies working within sports or healthcare were involved, thus bringing user needs into the focus.

The idea for an online game, *Game of My Life*, to support the life management skills of adolescents (aged 16 to 19 years) came from youth psychiatry experts (see Fig. 3). During the pilot stage of the game's development in 2012, common life management problems, particularly those related to mental health and substance abuse, were identified through target groups that were surveyed by nursing students. Cooperation with working-life experts brought valuable information about the game's target group. The main aspects of life management emphasised in the game included the use of intoxicating substances and money, as well as time management. The game was constructed by a game development student team in the visual novel style, which enabled interactions between different parties in the game and a collective participatory experience. A visual novel consists of a soundscape, static graphics, a first-person point of view and interactive decision-making events (Lu, 2014). The theoretical framework chosen for the game was a map of the process of a young person becoming independent (Ylitalo, 2011). Several experts and end users participated in evaluating the demo version of the game, and the feedback obtained was used to further develop the game.

The second iteration of game development was performed by a hired game development team. The extended project team also included a nursing student and two senior lecturers (in the areas of game development and nursing and health care). This second phase of game development had a more multidisciplinary approach: Experiences from previous projects helped experts from the nursing and health-care, IS and BIT fields to work together and understand one another better. Communication was easier and followed the iterative SG development process as presented in Figure 1. An important lesson learned was that a good understanding between different stakeholders is key for successful SG development, including a comprehensive analysis and a good understanding of the aim and players of the game being developed.



Figure 3. Snapshot of Game of My Life (<http://www.elamanipeli.com/>).

In recent years, the focus has been on developing virtual education environments for sports and nursing students (see Fig. 4). In one of these games, the aim is to check and locate possible security issues in the home of an elderly resident. During the game, players are taught to follow a safety checklist and therefore learn how to systematically check for certain issues in a home. These problems might be missing safety bars in the toilet, bad lighting in the hallway or electric cords inconveniently located on the walkway.

This game is based on environmental checklist (provided by the national administration), which offers methods to prevent fall-related incidents by the elderly. The game was developed in cooperation with sports education students, who designed all the teaching and virtual environment content. The sport students participated in the testing of the game and presented their development ideas while the game was developed.

The virtual environment was then created by a professional game development team based on photographs of a real apartment. The lecturers and students combined their expertise to create an ordinary and authentic virtual environment that resembled an apartment where elderly resident might live.

The developed experimental demo game had new game-play elements, and their suitability for educational scenarios was tested. At the start of the game, a randomised apartment with varying security issues is created. Players can move around the apartment using either the mouse or a combination of mouse and keyboard. The player can open a checklist which contains a series of possible safety issues. Once all the possible issues have been located and checked, the game will check whether the player's estimation on these issues was correct. The player can then start a new game session with a new randomised apartment with different safety issues.

This SG project served as a very professional educational method right from the beginning. The time allocated for its development was very tight, so each phase had limited resources. In addition, a multidisciplinary approach meant dividing roles: The game development team had a producer who was a contact point for all necessary experts and other stakeholders. The content for the game was provided by the sport students, and they also arranged the testing period.



Figure 4. Snapshot of the developed safety checklist game.

The most recent game production was a virtual reality (VR) game to simulate and demonstrate aging impairments. The aim was to offer to nursing students a way to experience how aging can complicate daily activities.

A professional game development team combined forces with nursing students with experience in elderly care and a gerontological nursing teacher. The collaboration started with a visit to a VR game laboratory for orientation. The students provided game content by writing a manuscript concentrating on different age-related issues that might cause problems for the elderly during their daily activities. During this writing process, there were some problems understanding the limitations and possibilities of the VR, and students were given feedback from the teacher and a game expert. Lastly, the game developers created the game content according to the suitable manuscripts, and it is now in the end user testing phase.

Based on the games that have been designed and implemented to date, several lessons in relation to SG development have been learnt. This section therefore describes how multidisciplinary expertise was utilised in the SGs design. The data are based on previous SG development projects that are provided in Table 1 (cases 1 to 6).

As summarised in Table 1, several issues were identified. A lack of communication and limited understanding were noted in several cases. It also appeared that the developers were comfortable with their own ways of working, and communication between the different teams was problematic in some cases. Lack of information sharing and the undefined roles of participants were also noted. However, the differences among the participants were also seen as adding richness to the teams, as verified by the positive remarks (i.e., regarding increased understanding, in-depth analyses and rich experiences) from the team members.

Case/ link	Team	Positive remarks	Negative remarks
1 Dance game http://bit.ly/2tJHmjN	Game development (GD) students, a sports instruction student and lecturers	Game development was documented through two thesis papers Students had clear roles in design and development phase	Lack of communication and common understanding Different thesis guidance protocols
2 Rehabilitation of stroke patients https://youtu.be/JnObHk7iqtg	GD students, lecturers from nursing and health care, experts and end users	Developed an understanding of the SG design process for nursing and health-care staff Integrated end users (patients) in the early phase	Different ways of work that caused complications and delays
3 Virtual training environment http://bit.ly/2v5JCFg	Professional, hired GD team, project manager, experts from companies and different disciplines	Integrated companies (sports and rehabilitation) in designing and testing Iterative development cycle with several user-testing periods	Lack of documentation Sharing information was not thoroughly systematic
4 Life management skills http://www.elamanipeli.com/	Hired GD team from students, project manager (IT), expert from mental health nursing, working-life experts, nursing students and end users	Took user needs into account and involved end users and working-life experts. In-depth analysis phase by multidisciplinary team Iterative development with agile methods (SCRUM) Good documentation, testing and evaluation phases	At first iteration, there was communication problems between nursing and GD students and lack of joint working methods Roles of experts were not clarified thoroughly
5 Security issues http://bit.ly/2w6cQ4l	Professional, hired GD team including game producer, sports students and a lecturer	Competent game producer dealt with communication with all stakeholders Good and clear expertise, roles and tasks	Limited resources
6 VR aging impairments http://cse.fi	Professional, hired GD team including game producer, gerontological nursing teacher and nursing students	Competent GD team and existing working methods in multidisciplinary projects Expertise and end users involved	Understanding the limitations of VR games and development time

Table 1. Comparison of different SG development projects.

5 Tools and Methods for the Analysis Phase in SG Development

This chapter presents a new tool and two methods that can help multidisciplinary teams work together during the development of health games. Since it is essential to involve different stakeholders as early as possible in the game development process, these tools are primarily for the ideation and analysis phase. As lessons learnt from several SG development projects (Table 1), the aim was to develop tools and methods for enabling better co-operation and communication between different participants.

5.1 SG Rapid Prototyping Workshop

The idea of providing a prototyping workshop for the development of SGs emerged as a request from health professionals. They wanted to learn more about gamification and SGs and to ideate new tools for their patients in the form of SGs. After the first two workshops, a model for an SG rapid prototyping workshop was created and offered to other professional and multidisciplinary audiences. Depending on available time, two versions of the workshop have been developed. Both workshops include the following:

- A quick introduction to SGs and how they differ from gamification
- The basics of game design
- A presentation of SG design canvas (see Chapter 5.2)
- A discussion and group work (3-4 people per group) to ideate an SG according to a given assignment

In the shorter workshop, the end result is an SG design canvas, and in the longer workshop, a paper prototype is also developed. At the end of workshops, all the results are presented with a 1- to 3-minute pitch (depending on the number of groups), followed by a vote for the best SG idea.

After a workshop, feedback from the participants is gathered. This was first done through discussion, but now this has been gamified, and a questionnaire is handed out at the end of the workshop using Kahoot (<https://kahoot.com>). This enables evaluation and further development of the workshop method.

5.2 SG Design Canvas

The current version of the SG Design Canvas is presented in Figure 5. The SG Design Canvas was inspired by the game design canvas of Carey (2017), but it was formed differently and has different supporting questions. Carey's (2017) game design canvas, that is inspired by Business Model Canvas (Osterwalder & Pigneur, 2010), is intended to be used as "easy to share, understand and update" game design tool.

The SG Design Canvas gathers ideas and thoughts of a serious game into a one sheet of paper. It consists of three different areas. At first, the goal and experience of the game is described, in line with the target group and the player. This also covers the broader design lines for the designed SG such as a genre and a game concept. Secondly, the SG design canvas guides to think the wanted influence or change, the graphical style of the game, game mechanics, feedback mechanisms and interaction. Thirdly, it is time to describe resources, the budget, platforms, distribution channels and the business model.

The SG Design Canvas is aimed more at experts outside the game development area who have either a need for an SG or an idea for one. When working through this canvas and the related questions, either alone or with a group, an SG idea is formed so that the following discussion with the game development team is easier. When all of these aspects are considered in the early phase of a project, it is easier to understand, for example, limitations of the game platform or needed development resources.

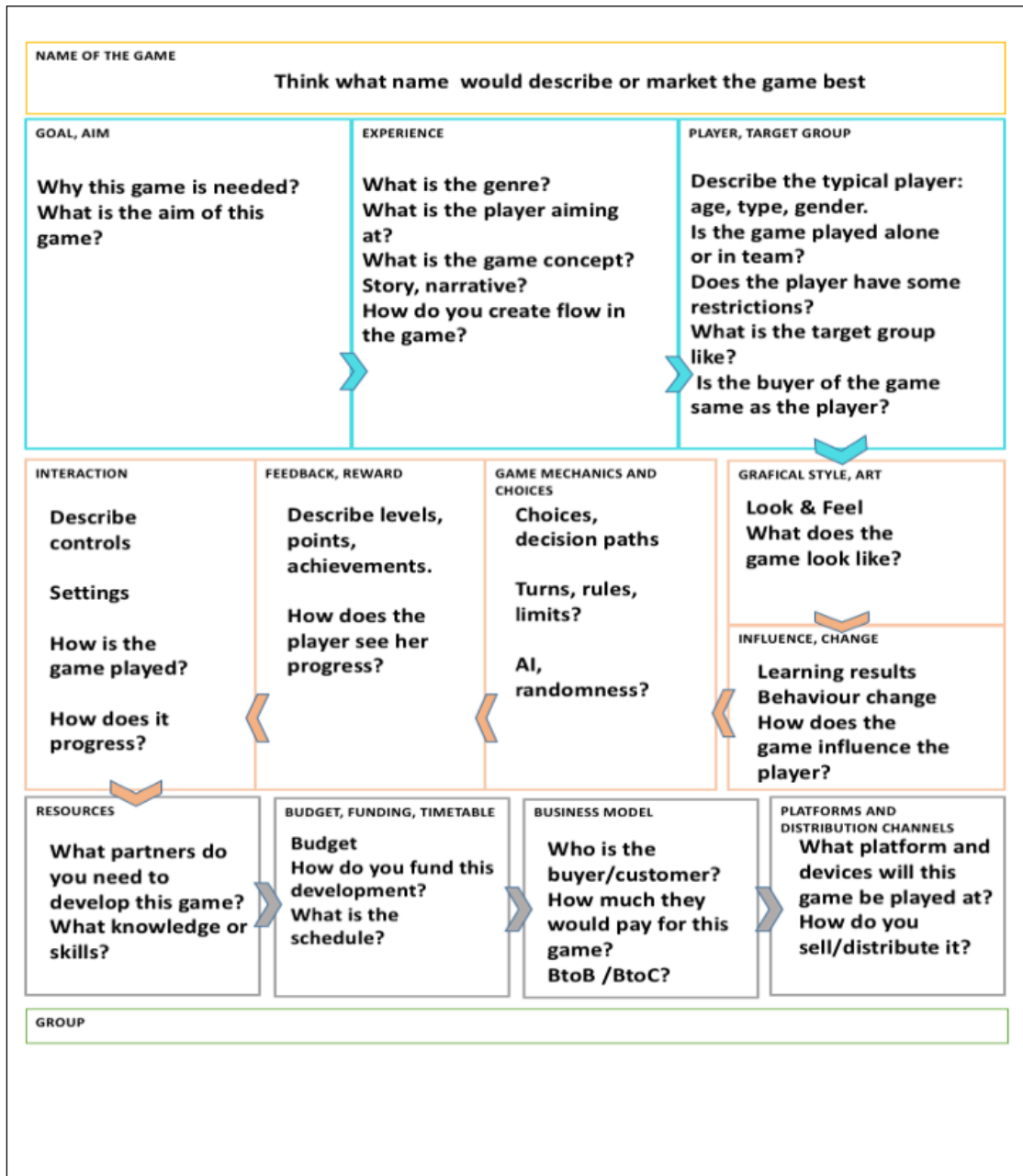


Figure 5. SG design canvas.

6 Evaluation

The framework introduced by Hevner et al. (2004) includes several means for evaluating an artefact. In this study, the evaluation of the SG design canvas was performed through observational case studies of multidisciplinary projects, including iterations and further development. After the workshop, feedback was received from participants and carefully analysed.

The DSR guidelines, when applied according to Hevner et al. (2004), ensure that a research method is properly utilised. These guidelines are as follows: 1) The developed artefact is a defined set of tools that allows multidisciplinary collaboration; 2) the identified problem regarding multidisciplinary collaboration is viable, especially for developing SGs for health-care settings; 3) the designed artefact

is implemented using methods supported by earlier knowledge and experience; 4) the implementation provides new knowledge related to the designed tools and to the knowledge base; 5) the research approach is applied with rigor, and guidelines are followed; 6) the final artefact is produced after multidisciplinary cooperative actions and related procedures are followed when seeking for a functional output; and 7) the study is discussed in its environment, and the results are presented in scientific forums.

7 Discussion and Conclusions

The purpose of the current study was to add to the current knowledge base regarding the use of multidisciplinary expertise for developing SGs. Thus, earlier studies have been analysed, and six cases were analysed in relation to an SG.

The SG concept has been around since the 1970s, especially in educational contexts (Ricciardi & De Paolis, 2014). Since then, SGs have spread into several other disciplines and environments (Susi et al., 2007; Kaleva et al., 2013; Djaouti et al., 2011). The current study focused on the use of SGs in health care.

SG development has always adopted a multidisciplinary approach, and expertise from the game subject area is needed for this process (Kemppainen et al., 2014; Merry et al., 2012). However, this study found that working with multiple disciplines leads to challenges in communication and that there is a need for a common understanding of issues. Table 1 sums up several of these potential issues. For example, there can be different working methods and timing among team members; game development teams should name one contact person who deals with the communication between all stakeholders and shares information; and experts should be able to define the desired and other possible outcomes, understand game development limitations and needed resources and have a clear understanding of their roles and tasks in the process.

Regarding **theoretical implications**, the study mentions the need for many disciplines to be involved when designing and implementing SGs. Especially in health-care environments, the hierarchy between participants in a development project may influence collaboration and communication. On the other hand, education and knowledge increase fruitful collaboration in multidisciplinary projects. Regarding **practical implications**, this study proposes that some education about the SG development process should be offered to health-care professionals that are participating in the development process and that tools and methods for the analysis phase should be introduced to the developers and other professionals.

Besides lessons learned, the study has revealed interesting tools and methods for the analysis of newly developed SGs. The workshops that were built to provide real-world experience based on prototyping appeared valuable as they provided a quick introduction to SGs for those unfamiliar with the process, an explanation of the basics of game design and space for discussing and proposing ideas. Thus, as **practical implications**, rapid prototyping workshops can be effective, especially in projects that include developers with versatile backgrounds.

In addition to the idea of multidisciplinary workshops, this study introduced an SG design canvas that can be used by experts who are not familiar with game development (see Fig. 5). The value of the design canvas lies in both the concepts it includes but also in the process it supports. One can assume that the proposed design canvas also supports a participatory design process and invites users to contribute early in the development process (see Gulliksen et al., 1999; Lukosch et al., 2012).

Furthermore, the designed canvas can be used in collaboration with the iterative development process introduced by Korhonen and Halonen (2017a). Future work should consist of evaluating the use of both the workshops and canvas and developing them further according the results of these evaluations. Further studies are also invited to analyse the usability of the designed canvas in SG environments.

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