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Success Factors in Finnish Serious Games

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Completed Research

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Abstract

Serious games (SG) are computer- and video games with a primary focus other than entertainment. This is, they are made to educate, teach, inform and promote ideas. The current research focused on SGs' success factors and their emergence in SGs published in Finland in 2015.

The research approach was qualitative and the research method was theory-based content analysis. First, the concepts of SG, SG design methodology and learning were discussed based on existing knowledge. Success factor related knowledge was summarised from the literature. Second, an analysis structure with categories and subclasses was formed deductively from the literature. Categories were used as they were defined in the literature, but more adaptive approach with subclasses was seen necessary to avoid losing the rich details in the material. Third, the empirical part of the study was arranged to collect, organise and analyse material related to SGs as restricted by the title. A goal was set to find out the level of success factor knowledge utilisation in the current SG development.

Briefly, five success factors seen from differing angles were detected: The role of the actor is chosen and focused intentionally. The available areas of experience complete each other. The game concepts aim to activate players to self-directed learners. Adjusting measurement-based learning experience optimises aimed influence. The orchestrated use of SGs includes pre-playing to support motivation.

Lots of variation was detected in the level of success factor awareness between the games. A couple of high quality games arose from the material and thus in this sense the overview of the Finnish SG industry describes the situation of the Finnish game industry. On top of the identified success factors, the analysis structure was built to be used by other SG settings and international contexts.

Keywords: Serious game, Success factor, Gaming experience, Content implementation, Implementation process, Analysis framework.

1 Introduction

The purpose of the study was to find out if and what kind of success factors are identified in Finnish serious games (SGs). As a concept, SG has been defined in several ways. In the definitions, the core content seems to emphasise the difference of the main purpose of the game when compared to entertainment games (Stapleton, 2004; Michael and Chen, 2006; Alvarez and Djaouti, 2011). In general, the mechanisms to classify SGs support evaluation and research of games (Alvarez and Michaud, 2008; Djaouti, Alvarez and Jessel, 2011). SG design process is a pedagogically driven and technically challenging task. The methods of designing SGs are based on combining entertainment with the serious content (Amory, 2007; Arnab et al., 2015.)

Learning is seen as an important goal of SGs. Wouters et al. (2013) reported how SGs increase motivation and modify the cognitive processes of the players. Ke (2009) analysed quantitative and qualitative influence of SGs in a meta-study of 89 studies about using SGs. However, meta-analyses do not include exact technical characteristics, and thus games are not classified on the grounds of comparable criteria, which reduces their value (Connolly et al., 2012; Ke, 2009; Wouters et al., 2013), and success factor analysis would be a challenging task from the meta-meta-analysis point of view.

In spring 2016 Finland was located at the virtual frontline with its successful solutions of virtual reality (O'Sullivan, 2016), and the growth of Finnish mobile games has surprised many of the game developers since the early 2000s (Lapintie, 2013). The success of the games guided us to analyse if SGs have been able to adopt similar success factors. Our study was based on literature review and empirical analysis. We decided to analyse existing SGs and limited our empirical material to focus in SGs published in 2015. Our research problem about identifying success factors in Finnish SGs was formed into a research question: What are the success factors that influence reaching the goals of SGs?

As the main contribution of the current study we introduce the developed structure for analysing success factors of SGs. The study is first of its kind, and it offers a structure for analysing other games but SGs as well.

Next, the paper presents essential earlier knowledge related to the topic, it continues with introducing the research approach and describing the results, and it ends with a discussion and conclusive words.

2 Related background

Success factors are those factors that, if well managed, ensure success for the work (Boynton and Zmud, 1984). However, Day and Wensley (1988) note that not all separate success factors are beneficial especially if they are chosen on light grounds and just quickly listed. According to them, more important is to identify the sources of success factors that lead to gaining advantage and overwhelming performance.

Related to SGs, success factors can be analysed based on the output of SGs. Gamberini et al. (2008) note that SGs include also 'therapeutic games' and describe their use especially in elderly care. They focused on the output of playing from the rehabilitation point of view. Later Djaouti et al. (2011) developed a G/P/S model to classify SGs in a way that takes into account both the entertainment element and the serious side of a game. It includes three main aspects (Gameplay, Purpose, and Scope), and they are divided into sub-classes that can be used when seeking games for different purposes. Their model helps people to choose a suitable game for the pre-defined purpose, and instead of providing a detailed analysis of skills that can be supported by SGs the models intends to build a common ground to browse the whole field of SGs. Based on the mentioned three aspects Alvarez and Djaouti (2011) delineated two characteristics for a SG: 1) it combines a video game and functionalities such as broadcasting messages, training, exchanging data; and 2) it focuses on other market but only entertainment.

When comparing SGs with pure entertainment games, Susi et al. (2007) point out four aspects: tasks or rich experience; focus; simulations; and communication. According to them, SGs provide a gaming experience where the gaming environment is planned to transfer beneficial content, differing from purely entertaining games. They continue that not all salutary 3D applications are SGs.

Based on the goal of SGs Bergeron (2006) divided games in activism, advertising, business, physical activity, healthcare and medication, news and political games, while a few years later Alvarez and Michaud (2008) delineated that SGs are divided based on their target sectors defence, education, advertising, information sharing, healthcare, culture, and activism.

According to Kiili (2005), while representing persuasive technologies, SGs need to include factors that enable experiences of flow. To maintain experiences of flow Kiili proposes that a SG should use agents to guide the player. In case the game gets too hard for the player, the anxiety agent should make the game easier or support the player. Respectively, if the game becomes too easy, the boredom agent would place additional challenges to keep the player busy experimenting, experiencing and learning. Kiili also highlights the need to design carefully the agents to avoid intentional underperforming when pursuing rewards. To achieve flow introduced by Csíkszentmihályi (1975) Kiili proposes eight key points to be noted: fitting with the player's skill level, clear goals, focused attention, unambiguous feedback, a sense of control, playability, gamefulness, and a framing story. The depth of flow can be evaluated with eight criteria (Sweetser and Wyeth, 2005) including e.g. level of concentration, challenge, development of player's skills, social interaction, and feedback.

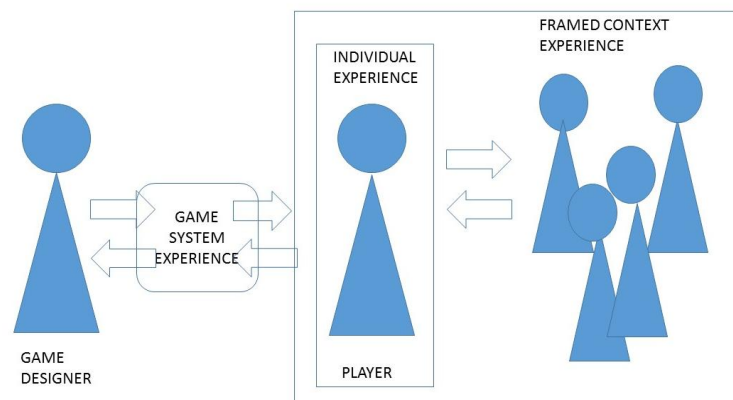Nacke et al. (2010) propose a framework of three categories to evaluate game experience (see Fig. 1).

Figure 1.   Measuring gameplay experience.

The categories defined by Nacke et al. (2010, p. 5) are Game system experience (the quality of the product), Individual experience (the quality of human-product interaction) and Framed context experience (the quality of interaction in a social, temporal or other context). These categories are interacting with each other over the time and they can be evaluated when developing the games. Related to game experience, Petridis et al. (2012) talk about high-fidelity serious applications, and in addition to the significance of meaningful content they highlight the role of visual fidelity, accessibility, heterogeneity, composability, and networking when building compelling SGs.

SG design theories give guidelines on how serious game implementation process should be organized and conducted (e.g. Amory, 2007; Arnab et al., 2015; Bellotti et al., 2009a). Yeh (2015) points out that when designing and building game environments it is important to consider the general nature of game experience in relation to the goals of the SGs. For example, action games have been adding creativity and managing negative feelings. However, not all observed behavioural changes

triggered by action games are positive, Yeh continues. Bellotti et al. (2009a) propose developing SGs using a task annotation model, and utilising experience engine (Bellotti et al., 2009b) to reach more reusable and adaptive experiences.

The role of SGs has been emphasised especially from the educational and pedagogy related games' point of view. For example, Amory (2007) describes an object oriented Game Object Model to help design of pedagogically rational learning games. Also Arnab et al. (2015) take a pedagogical approach to SG design as their LM-GM model combines learning mechanics and game mechanics. Specifically they point out the value of LM-GM model with its ability to support evaluation of SGs that recognises low-level mechanics and their connection to pedagogical purposes.

3   Research approach

To find out how and if the success factors of SGs are seen in reported game releases publications, a qualitative content analysis was applied. Hsieh and Shannon (2005) note the importance of defining the specific approach beforehand, and to create an analytic process to guide the actions. In our case we decided to apply a process that used a literature review as a baseline, giving a map of what is known and offering us a structure for the analysis. In addition to that, we acquired empirical material with the help of the planned structure that is described later. A research diary was written to be used also in later studies.

Content analysis can be divided into three phases: first, one needs to get familiar with the material; second, the material is condensed with an iterative process; and third, the condensed research material is interpreted and reported (Forman and Damschroder, 2008). Condensing the text and classifying it is central in content analysis (Weber 1990).

When applying content analysis researchers need to compromise because if they form the analysis structure based on the current empirical material, the results are seldom applicable in other environments. On the other hand, if the analysis structure is chosen based on existing research, there is a risk of losing valuable unique content at hand in the research. In practice, the researchers need to choose between generalisation and efficient invocation of knowledge. (Krippendorff, 1989.)

Next, we describe the process of how we ended to the empirical material. After that, the criteria for accepting the empirical material are presented. Then, the collection and creation processes are introduced. The literature review was used to reveal the high-level concepts for the success factors (see Fig. 2).

In the upper part of Figure 2 are the concepts and classes that relate to the organising and conducting of the implementation process (1.) and the contextual concepts having effect on how the players' motivation and commitment are set (2.). The lower part contains the classes that are more directly present in the released game product, containing the level of flow and rewardingness (3.), architectural efficiency (4.), and finally the concepts of content implementation (5.).
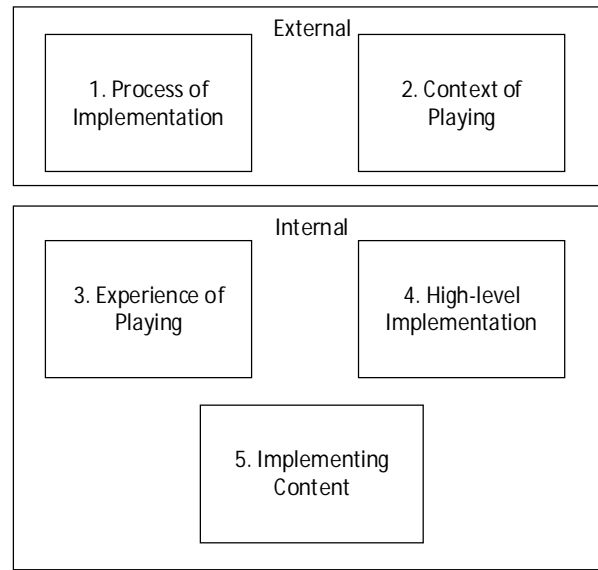
Figure 2.   The structure for analysis.

The subclasses were formed using concepts from existing research as a guideline. However, as progress was made with the research, the nature of each subclass became gradually clearer (as the expressions collected from the written material invoke the applicable analyses and inference methods for each subcategory). Process of Implementation consisted lower classes such as sharing tasks, interaction in the process of developing the game, areas of experience of the developers, and designing the content. Context of Playing consisted lower classes such as personal motivation of the player, motivating factors originated from the environment, requirements originated from the environment, mentoring focusing on the player, and influence of the gaming society. Experience of Playing included lower classes such as homogeneity of game experience, completeness of game experience, impact of flow agents, rewardingness of playing, and functionality of gaming mechanics. High-level Implementation included modularity, functionality of measuring, interactivity, and reusability of the game structure. Implementing Content included logic of introducing content, embedding beneficial content into game experience, dynamic adjusting of the contents, ability to activate, transferring beneficial content, and validity of the content.

The following selection criteria guided us to select the SGs into the analysis:

- A video game and beneficial content are included in the SG.

- The original purpose of the game is to be a SG.

- Either characteristics of entertainment or fun must be included.

Pure simulations, virtual environments and augmented environments were excluded. Instead, actual games were in the focus. A list of Finnish game developers (SGFC 2016) offered a good pool to select potential games for this study. Other fruitful sources to search for SGs were tweets from Games4Health and Facebook group of Play-Finland. In addition, games were sought by following web pages of game developers and especially from reference catalogues of subcontracting game companies. In all, a total of 35 candidates for SGs were identified. Out of them, 16 games were chosen for the study (name of the game / developer): Välkky Peikkoleiri 3/ Bitartic; Välkky Peikkoleiri 4/ Bitartic; Rubiiniguru / Peliporkkana; LounatuuliExpress / Peliporkkana; Opi viittomaan / Codespace; MoneyFlow Challenge / Afterlife; Aparaattisaari /Aniway; Moottoripaja Racing / Moottoripaja; MehuJehu The Game / Tingleware; Päiki Pörriäinen / Tingleware; Keeduu / Kasauma; BabyBakery /

TAMK; Minimiparit / Outloud; Leaping Leo / Outloud; Tuottava Esimies / MeKiwi; Puffy Numbers / NordicEdu.

The games were played and observations were recorded for further analysis. Information about technical details, versions and publishing date were recorded. In addition, information about required operating system, supported browsers and languages were recorded. The collected information consisted ca. 50 pages. iPad Air 2 tablet was used when analysing 11 games. The browser-based games worked best with Windows 10 in Firefox. In addition, Android phone, Android tablet and iPhone were used. Moottoripaja Racing was tested with Windows 10 /64 bit.

Research material was classified as Descriptions in the developer's site, Descriptions in the application store, and Observations done by playing. The documentation was read carefully and expressions related to success factors were highlighted game by game. It appeared that, in general, the brochures were written pretty much from commercial view instead of thinking about giving purely factual and informative content.

4   The results

The empirical material consisted of 16 games. On average, 11.9 observations were made from each of them. The observations were divided into the classes (see Fig. 2). Most observations (n=106) were into High-level implementation and least observations into Implementing content. Next, the results are reported class by class, according to the defined structure for analysis (Fig. 2).

4.1   Process of Implementation

As the material was analysed, it became evident that many participants in SG-production are aware that there are special requirements when developing games with structured narrative or purposeful exploration and pre-defined purpose.

In several SGs the development of the game was described as a result of work by many partners. However, the production of the game was not described as collaboration or sharing tasks. One could assume that the collaboration was not seen significant for the result or important enough to be reported. Documentation for the analysis of process implementation was available from seven SGs. It included expressions about companies and communities involved in the development, and their roles in the development. It appeared that there are often more than one actor in producing SGs, and that there is a customer who acquires the development from a specialised producer.

In Finland there are companies that are specialised into SGs, educational games and healthcare games. It also seemed that some sub-contractors get orders to produce SGs even if they are not profiled as SG implementers.

4.2   Context of Playing

The analysis showed that game developers could pay more attention to the pre-motivation of the players as this task is emphasised by the prior research.

Half of the games chosen into the study produced observations about context of playing and all of the observations were collected from the documentation of the games. In expressions from games focused on children the significance of home was emphasised. In two games the benefit of playing together with parents was highlighted. One game focusing on children's therapy recommended continuing therapy at home with the help of the game. Two games were about teaching life skills, working as foremen, and managing economic skills for adults and adolescents. They emphasised the usefulness of the provided post game reporting, and developing own skills at work after playing. The means of learning included reflection and discussions in groups based on learning.

Special interest to choose players based on their motivation was not seen. Only one game was close to having this objective as it mentioned continuing therapy through further playing at home. In this case therapy was the selective process. Some of the games were recommended to be used as part of education material and thus they might act as making study credits. This role was clearly mentioned related to two games. According to them, the certificate written by the game was seen valuable.

Mentoring was noted in three games. One game targeted to pre-school aged children contained special material for supervisors to enhance their performance in mentor role. Another children's game included a wish for parents that they would participate in playing the game and discuss the game with the children to help them comprehend the content.

In addition, the gaming society was noted in three games. However, the observations were somewhat related to the real world context and they were overlapping with earlier observations, and not gaining special attention.

4.3   Experience of Playing

Prior research (see Chapter 2) provides a good base to develop serious games that adapt to player profile. Unfortunately, practice seems to sustain an embedded view that the player should adapt to the game. This can be seen as a major obstacle on the road to effective SGs.

Evaluating the experience of playing was difficult due to the fact that the chosen written documentation was game developers' material only. Therefore one third of the research material in this class was collected from the games.

It appeared that no signs for agents to initiate flow were identified. In addition, no expressions about functionalities of game-mechanics were found from the written material. To avoid subjectivity, observations during playing were not done either. In two games, 'other observation' was noted regarding notable problems related to quality assurance and degree of difficulty.

In two games the unison of gameplay was remarkable. Those two earned marks as they had enough content and at the same time gameplay was solid and consistent. All content was located under a complete outlook and the game mechanics continued from one section to the other without surprises. In contrast, another kind of experience was offered by an innovative educative game with sections that were tied very loosely together.

Expressions about the wholeness of the game experience focused only on how meaningful the general audio-visual implementation of each game was while actual scenes in the game were not noted at all. This approach appeared more like advertising instead of informing.

The rewarding was noted by expressions like inspire, help, funny, competition, and no punishment for errors. Thus, one can assume that in SG-developers' view a pleasant game experience is a topic that is worth of mentioning in the documentation.

Internal badges could be collected in two games. In the first one, the badges did not match with the game's beneficial content although even designing the badges must have been a serious effort. The other game included errors in the badge system and it was not possible to find out their final meaning.

4.4   High-level Implementation

Serious games are often aimed at narrow target groups. This enables to reuse technology, game components and even content. A controlled solution portfolio could help a SG-developer organisation to operate more efficiently.

The empirical material did not reveal that the games would do any actual measurements in a level that SG-research operates. However, some of the games did provide a report about the player's perfor-

mance in the games. The reports were based on data collected by the games and they included mainly learning content.

The level and type of interactivity were seen as a topic that should be analysed. This sub-class received several expressions that formed the descriptive class of expressions of the high-level implementation.

In documentation of six games the interactivity was presented with expressions describing the avatar and how it should be controlled. It was evident that the avatars were tailored to match the target audience of these games. Two games allowed player to modify and personalise the avatar.

As the data collection methods of the research excluded technical evaluation and interviews, the possibilities to gain data of games' modularity, reusability or other general technical aspects were limited. However, the material contained games that already showed the potential of reusing technology in SGs.

4.5 Implementing Content

There were games that supported the prior research in the view that playing a serious game is just a start of the influential process. It seems to be evident that the games' abilities to activate and inspire players will determine the true success of SGs.

The content analysis produced a lot of condensed material including 86 expressions about implementing content into SGs. The analysis of the games added 20 observations into the empirical material.

The games were spread between a structural and free introducing of content. The structural approach was connected with a studious implementation, and the un-structured approach was connected with limited implementation in several areas.

The immersion of serious content was included in the structured analysis to enable the evaluation of developers' willingness to integrate different sections and to see if the integration was successful. Expressions about scenes in the game, pace of gaming, noticing the player's readiness, integrity of the storyline, and notes about natural manner of representation from the focus group's point of view were collected.

The content analysis did not reveal any special dynamic adaptation. However, one game included notes about using a pedagogic agent in a way that might refer to smoothening the content. Another documentation mentioned an assistant that was present in the game, and after the game it could be seen in the posters and as a character that was adventuring in a book.

An ability to activate was brought up in documentations of five games. Games that taught to carry out work tasks trusted on reporting and on the thought that the players would use the game as a mean of self-studying.

Voices were used in two SGs targeted for children's therapy. They relied on bringing the games as part of the therapy that allowed continuing the game at home if the children were motivated to play the games.

Transferring the beneficial content to the player is the main objective of the SGs, and thus a central part of the analysis structure. The topic was analysed by searching for expressions that described activation of will to learn and curiousity and also activity when playing. Three games trusted on inspiring. Other notes included learner orientation, adventures and exploration, and persuasion to learn.

It appeared that there were big differences on how the game developers perceived possibilities to teach and learn. Due to this, it was significant to collect and classify information about the levels of learning techniques that were used in the SGs.

4.6   Summary

Earlier studies enabled us to build a classification that allowed a structural analysis for exploring the SGs in the study. The model for playing was built according to earlier knowledge and without conflicts with the empirical material even if we could not verify all details of the model in the empirical material. What was lacking in the analysed SGs included mostly more demanding features of implementing SGs. However, this describes the status of Finnish SG development as an emerging area of teaching, influencing and game production.

As a whole, some of the analysed games appeared as well implemented in one or two areas of SG domain. At the moment of the study, some of the studios and developers were in their early phases and early career but some others were active and productive in developing new games. One can assume that the positive trend will continue.

Based on the results five success factors were built, each of them looking at SGs from different angles (see Table 1).

Angle	Success factor
Enterprise (game developer)	The role of the actor is chosen and focused intentionally and it guides the choices in the value chain of SG business.
Project	The areas of experience of the organisations complement each other and together they build a covered area of experience and expertise.
Requirement engineering	The game concept aims to activate players to self-directed learners and advocates for the beneficial content.
Game design	Adjusting measurement-based learning experience optimises aimed influence.
Use	The orchestrated use of a SG includes pre-playing activities that support the motivation of the player that belongs to the focus group.

Table 1.   The success factors of SGs seen from different angles.

The different angles looking at SGs are listed in the left column of Table 1. The right column includes the success factors as defined expressions. The success factors emphasise construction of a high-quality game as a result of collaboration of expert organisations. The wholeness of the game requires that the focus groups are carefully analysed and that the activities to promote the pre-motivation of the players have been considered already in the early phases of developing the games. The efficient and extensive transfer of the beneficial content can be supported by measuring activities in the game. Based on measuring, the gaming activities can be adjusted. The serious games are targeted more precisely than entertainment games, and re-using techniques of learning and gaming is not seen problematic. In addition, know-how of serious gaming includes skills to transfer the player the pertinent content that supports the players to deepen the influence of the games also independently.

5   Discussion

The purpose of this study was to reveal any success factors identifiable in Finnish SGs that were published in 2015. To reach its goal, the current study analysed Finnish SGs and their quality mainly with the help of available documentation of the games, but also with subjective observation when playing the games. In the study, success factors were sought from the documentation and from the observations when playing. First, the analysis structure (Fig. 2) was built based on earlier research. The analysis structure guided the analysis of the empirical research material that consisted of written documentation and gameplay-based observations. Only rigorously chosen SGs were included as described in

Chapter 3. Then, the observations and notes were carefully read and analysed, enabling understanding of the qualitative interpretation of the games and how they were introduced and emphasised in the documentation. Finally, the analysis lead to conclusions that were based on earlier knowledge and the current empirical research. A thorough research diary was written to be used in later phases of the study. The motivation for the study was based on the reported success of Finnish games in the 2000s (Lapintie, 2013).

Earlier knowledge reveals several definitions for SGs, and their main content emphasises the differences between SGs and entertainment games (Stapleton, 2004; Michael and Chen, 2006; Alvarez and Djaouti, 2011). In this study, SGs referred to Serious Games and Applied Games and the success factors related to known success factors as described in earlier studies. The efficiency of SGs has interested researchers a lot. For example, Ke (2009) analysed 89 studies and Connolly et al. (2012) analysed 129 papers. Our study included 16 games and the analysis was based on available documentation published in 2015 about the games and a limited set of observations made during the gameplay. The main contribution of the study was the framework that was built to enable the analysis (see Fig. 2). As such, the framework is adaptable to be used with any games that are to be evaluated.

The empirical material revealed that in large SG projects there often are separate orderer stakeholders, experienced SG organisations responsible for the implementations, and experts who produce the content. Moreover, some of the chosen SG projects included specialists that represented disciplines of education or psychology. The study also revealed that a SG must be visible and available, and only after that the motivation of the player is significant (see also e.g. Petridis et al., 2012). On the other hand, enough motivation is needed to continue playing and only rewarding playing experience enables to transfer the beneficial content of the games (see also Kiili, 2005; Sweetser and Wyeth, 2005).

The SGs chosen into our study functioned as experiments that measured learning skills. However, the empirical analysis revealed that the games measured the learning based on questions and distinct pieces of knowledge. When as its best, a measurement done by a game is an index that rises with emerging learning areas. This leads to a potential further research topic about analysing if this kind of measurement has any added value compared to a post-game multiple choice test or could a game-based test be the best tool to measure information transfer.

Based on decisions made during the design phase of the games, the chosen SGs filtered actively factors that might disturb transferring beneficial content or compete with it. For example, some commercials were left out because they did not match with the wholeness. Related to this, the chosen SGs seemed to emphasise the importance to recognise and identify the focus group whom the games are aimed at. If the focus group is not explicitly identified, the descriptive documentation cannot be detailed or explicit but, instead, remains on general level description.

6 Conclusions

The current study analysed gameplay by looking at playing experience and by identifying characteristics that supported positive outcome in the forms of flow agents, rewards, and benefits that lead the player to return to the game, for example.

As presented in Table 1, we could see five success factors in our study classified by different viewpoints: First, from the viewpoint of the enterprise, a company should have a focused view of its own development process role. Second, from the viewpoint of the project, it's essential that the expertise of participant organisations complete and support each other in each SG project. Third, from the viewpoint of the requirements engineering, the means for post-playing activation of players should be thought of in early phases of development. Fourth, from the viewpoint of game design, measurements (and the adjustments based on them) should be designed to be part of the influential experience, and fifth, from the viewpoint of use, using a serious game includes actions that support the motivation of the focus group.

The success factors (Table 1) were found with the developed analysis framework (Fig. 2) that consists of Process of implementation, Context of playing, Experience of playing, High-level implementation, and Implementing content.

Our study offers one approach to identify and analyse success factors in SGs. As the current study was limited only on SGs published in 2015 in Finland, more extensive studies are needed especially from other parts of the world. In addition, as SGs have been available since early 2000's, a longer timeline is recommended for further studies.

More studies are needed to find out if the analysis structure (Fig. 2) can support game-related analysis in general. As the introduced analysis structure focused on analysing success factors in SGs it would be interesting to analyse how it relates to methods developed for analysing gameplay experience (see e.g. Nacke et al. 2010). In addition, SGs and their role in supporting everyday life are still in their early years, and as new technology emerges one can assume that new solutions and possibilities enabled by this new technology in many business areas and life in general will be seen in the near future.

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