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LeanGame, a digital training tool to implement Lean Philosophy

Jasperiina Mattsson^{1*}, Raija Nurminen^{2,} and Tero Reunanen³

¹ Turku University of Applied Science, Finland ² Turku University of Applied Science, Finland, University of Eastern Finland ³ Turku University of Applied Science, Finland, Tampere University of Technology, Finland

Abstract. One of the most important resource of successfully leaded and managed health care organization is a competent staff. As staff education requires resource investments such personnel's' and educators' time, facilities and thus, typically it have to be funded somehow, money, it would be feasible to try to develop a new, more efficient and more motivating training methodologies and tools, in order to enhance learning outcomes. Health care has large amounts of employees, which gives border condition to tool to be also suitable for large amounts of people. As new digital technologies are available, they offer new ways to execute corporate wide professional training, e.g. serious games. This article presents a new approach to Lean training: a digital LeanGame. It is a digital serious game aimed to introduce basics of Lean Philosophy to health care professionals in hospital environment. Its future users, a group of health care professionals piloted LeanGame in Finnish hospitals in spring 2017. The results of this pilot study show that digital LeanGame can be used in a complementary way to achieve training goals in lean training. This article handles the results of lean game training and discusses of future research and development needs.

Keywords: Digital Game-Based Learning · Serious Games · Lean · Training Health care · Hospital

1 Digital game-based learning

An educational game is "an instructional method requiring the learner to participate in a competitive activity with preset rules" [1]. Serious games is a concept with numerous definitions. In a broad sense, the term refers to games that are used for a purpose other than mere entertainment. Usually they are used as a tool to pass knowledge or information and to enhance skills. Digital serious games can be played using multitude digital technologies such as computers, consoles and mobile devices. The most common platforms for delivering of digital serious games are PC or laptop, followed by video console and online games [2][3].

The idea of playing games for educational purposes is not a new one. The studies show that they have been an integral part of all societies even in the ancient history. The military has used serious games in educating for a long time. For example, during the World War II, wargames were used to train the US army. In the last decade, interest towards serious games have grown exponentially and they have become a remarkable business as well. [4]

Digital game-based learning has identified as one of the most promising educational approaches for training advanced skills [5]. Different researches show positive learning impacts of digital games. The most common effects are knowledge acquisition and developed problem-solving skills. In addition, games provide growing motivation as one outcome. [2] Unlike traditional teaching methods, the serious games present a learner centered approach. In other words, their user's role is active when the trainee controls the learning process interactively. Learning method is usually problem-based. Method is based on the educational philosophy by John Dewey [25]. Games also provide a real-time feedback for self-assessment and the possibility for the learner to test his/her hypotheses. These same facts are associated with how people learn [6]. Serious games have serious goals. To reach these goals the players' enjoyment is important. An efficient serious game adapts to players needs and interests. Playing a serious game must have the fun- factor to support players' motivation and involvement. [4] According to the Vygotsky's theory of learning, zone of proximal development exists between real and potential levels of development [24]. Scaffolds (e.g. temporary support) have been used in digital games and they provide the necessary support and guidance that learner need to prevent frustration. [23] Scaffolding tools encourage to development problem solving strategies and therefore they facilitate the zone of proximal development [24].

In past few years, an interest towards games designed for training purpose and their use for education have increased [7]. As response to hold the competitive advantage in business and new technical opportunities, many companies have adapted digital serious games as a corporate wide educational method. They are often used for training staff, inducting new workers and increasing internal communication. [8]

1.1 Health games

Health games is a wide concept of different games that aims to improve wellbeing, e.g. by affecting individual's behavior. Commercially available games have been used for therapeutic purposes since the early 1980s and they were used for children. Today, when the technology has offered possibility to more sophisticated applications, the games are used also for older patients. [9] Commercial games can also be used for pure entertainment, such as Wi fit [3]. Tailor-made games for different health purposes are specifically designed to deliver health related information and to provide a platform where patients can repetitive practice a positive behavior. They involve patient to commit to treatment. [9] A Finnish project "Play for Reward" studied digital games as a part of rehab process of patients with brain injuries [10]. Games for health domain also includes games designed for medical and health care education. Number and genres of games affecting people's health are expected to increase [11]. Health care professionals' continuous education is necessary for e.g. patient safety. Training and educating have to be practiced during their whole career, not during school years only. Nowadays serious games are used in many different professional fields in medical and health care domains and for various training goals [12]. It is researched, that some commercial games are training the same skills, that are needed in surgical profession e.g. coordination and hand-eye cooperation. These kinds of games have indirect clinical meaning because they promote quality. E.g., there is evidence that by playing certain video games the physician improves surgical skills, makes fewer mistakes and is more efficient in performing laparoscopy. [9]

In the review research of serious games, developed for health care professionals, Ricciardi and De Paolis (2014) grouped serious games for eight different group by their application area: surgery, odontology, nursing, cardiology, first aid, dietitian and diabetes, psychology and the others. There is difference in numbers and quality of serious games between different health fields. For example, First aid, triage and mass emergency, is a field that typically requires continuous training and there have been many serious games developed for those needs. [13] Despite of the fact, that those games designed for medical training have growth in numbers, they are still in their infancy compared with the games designed for patients [9].

Educational games for health care professionals are designed to improve their knowledge, skills and performance and to change their attitudes. Nowadays educational games are a growing domain as a health care training platform. [12]. There are several literature reviews done from serious games designed for health care professionals. Research aim for Akl et al. (2013) was to study the effect of educational games on health professionals' performance, knowledge, skills, attitude and working satisfaction. Authors found many advantages from educational games. Digital games' competitive nature motivated participants and some of those games had potential to enhance communication between team members. In addition, games helped its players to become more responsible for their own learning. According to this review, there is still need for more research to assess thoroughly the outcomes related to performance and care, as well patient outcomes. [14]

Abdulmajed et al. (2015) concentrated their study to mostly on identifying trends and scrutinizing an assessment tools in educational games for health care professionals. Although they did not find evidence on affects for long-term memory, their study showed that there was initial increase in cognitive ability. They stated that educational games are a powerful teaching strategy. [15]

1.2 Digital games for Lean training

Games are typically used to illustrate the concept of Lean and there is a high number of real games in that specific domain. Manual simulation is a useful method to familiarize to the core themes of Lean, as process thinking and removing waste. However, digital lean games are not so common. [16] Digital game has many advantages versus manual simulations. First, it is a cost-efficient way to train a large amount of people. Digital game does not require any physical presence, so it is not depending on time nor place. Manual simulation takes several hours, whereas digital game can take less than an hour of valuable working time. As it is apparent, from general searches on the internet, the digital "LeanGame" presented in this article, is not the only one designed to implement Lean thinking. De Carvalho et al. (2014) wrote an article from a digital "The 5S Game". In that game, the players train the 5S method in four different scenarios. De Carvalho et al. studied "The 5S Game's" effectiveness as an educational tool and compared it to the manual Lean game. The results showed that "The 5S Game", as well manual simulation, promoted trainees' motivation and knowledge acquisition. [16, 17] There is also a digital "the Lean Bicycle Factory", done by a Swedish company, which is designed to teach Lean thinking and improve the effectiveness of the process of bicycle production [18].

2 LeanGame

Digital "LeanGame", presented in this article, is designed by Turku University of Applied Sciences' Business Competence and Process Management RDI-group (BCPM) and Turku Game Lab with the Finnish Hospital Districts of Southwest Finland, Satakunta and Vaasa. The game is aimed to introduce basics of Lean Philosophy to health care professionals in hospital environment. Thus, it is a tool to implement Lean in the hospital environment.

The goal of the "LeanGame" is to encourage the health care professionals to see their work and working environment from a different angle. At the same time, the players are being involved to develop their work and tasks, by e.g. cutting of useless, non-valuable work phases i.e. waste. "LeanGame" is placed in hospital and its story is a day in the emergency unit, as a worker. The game is consisted from main story including smaller tasks, the mini games, in game that shows practical implementations of Lean Philosophy in emergency units' everyday work. As an example, the warehouse mini game demonstrates how much ordering and standardizing work place saves time. "LeanGame" is an interactive learning tool where players' choices changes how the story continues. The game also offers a feedback in the end.

2.1 Pilot Study

Since "LeanGame" was developed for real need of early mentioned hospital districts, the need to assess "LeanGame's" results as an educational tool was done by its future users: health care professionals. The assessment was executed through a pilot study in Emergency Medical Service and Radiology Units of The Hospital District of Southwest Finland. The study was conducted in the spring 2017. The participants (N=82) were a group of staff working in Emergancy Medical Service and Radiology Units. Response rates were n=19 and n=16 respectively. Hence the total response rate was 42.7 % (n=35).

The game link was send to the staff members in the same email as a questionnaire link. The Webropol®-based questionnaire contained 14 questions, both quantitative and qualitative.

The research questions in this study were:

RQ1: How did the participants experienced "LeanGame's" playability?

RQ2: How did the participants experienced digital game as a learning tool versus more traditionally training methods?

RQ3: Did the participants learn about Lean Philosophy?

During the pilot, there was a few technological difficulties, which lead to different arrangement between two different study groups. First, the study plan was to use the computers of the Hospital Districts, but they were partly outdated and not sufficient from their performance enough. Therefore, the pilot was conducted with a separate laptop and a tablet. The participants of Emergancy Medical Service started playing with their own devices and they played during their worktime whereas the participants of Radiology Unit had separate playing sessions. All the participants were requested to answer the questionnaire right after their playing experience.

2.2 Results

The study groups consist heterogeneous professions and level of Lean knowledge. The age of respondents ranged between 20-65 years old and 65 % of them had participated in some Lean training during last year (Fig. 1). In Radiology Unit 94 % of all staff had some previous Lean training, in the Emergency unit that percentage was smaller, 21 %. Before the game, almost all respondents (94 %) felt that Lean Philosophy is useful in their own work.

In the qualitative questions, "LeanGame" was described easy and "simple enough" and during the pilot, there was no barriers reported in players technical-skills. According the background questions, 94 % of the participants used information technology daily in their work and the rest of them used it at least every week.

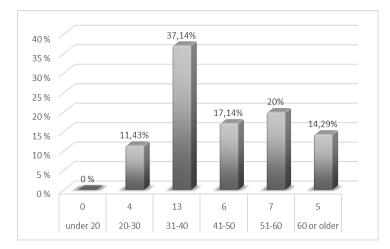


Fig. 1. The age of respondents ranged between 20 and 65 years.

The result of **the first research question** of "LeanGame's" playability was a collection of development ideas for the next version of the game. Ideas were shown as recommendations. The participants made suggestions for the game's technical and content properties. During the pilot study it became very clear that that not all computers, in the Hospital District, were capable enough to run the "LeanGame". They did not have, for example active WEBGL, which is needed in Unity based games. The participants also hoped that the next version of "LeanGame" would work better in Internet explorer[®] -browser, which is a default browser in the test organization's computers.

For the "LeanGame" itself, the players made several suggestions. They asked a chance to put the game into a pause. Given the nature of work in the emergency duty, it is clear that worker cannot always play serious games without interruptions, even when game is developed to be quite quick to play. "LeanGame" was developed to be played through in 30-45 minutes. The participants also asked for instant feedback after every task and mini game. "LeanGame's" feedback was given mainly in the end. The players were also after more information about the right answers in different tasks and some of them were hoping for discussion sessions about Lean after the game. All players' feedbacks were collected and analyzed. The results were reported and given as recommendations for the next game version and given to the BCPM-research group and Turku Game Lab. This feedback is used in order to provide information for to the decisions made for the development of "LeanGame v. 2.0".

"LeanGame" was the first digital serious game in the Hospital District of Southwest Finland. Therefore, **the second research** question was about participants' experience of digital game as an educational tool. Answers were mainly positive. From respondents 51 % would like (agree/strongly agree) to take part to an educational session executed with digital games in the future. The same amount of them felt that they learned better with "LeanGame" than by traditional teaching method e.g. lecture. In the qualitive questions one player described "LeanGame" to be more clarifying than lectures or manual "Lean Kata" simulation. The 51 % of the respondents would also recommend "LeanGame" to their colleagues (Fig. 2).

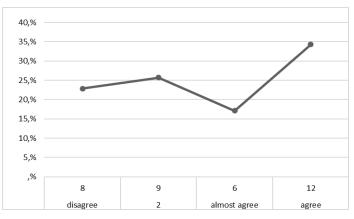


Fig. 2. The answers to the statement "I will recommend LeanGame to my colleagues".

As an answer to **the third research question** 54 % of the respondents agreed (almost agree/agree) with the sentence "LeanGame increases knowledge about Lean Philosophy". Sixty-one percent of them considered (almost agree/agree) that the game helped them to implement and use Lean Philosophy and its tools in their everyday work. One respondent, who already had wide knowledge about Lean Philosophy, underlined that the game "did not teach him anything new about Lean".

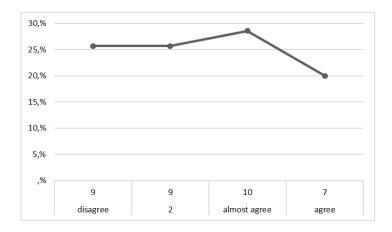


Fig. 3. The answers to the statement "LeanGame helps to identify waste in everyday work".

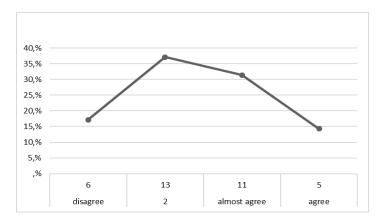


Fig. 4. The answers to the statement "LeanGame helped to identify waste in care process".

In the questionnaire, there were two questions about waste and how participant experienced LeanGame influence about it. 49 % of the participants felt (almost agree/agree) that LeanGame helped them to identify waste in their everyday work (Fig. 3), 46 % of them felt (almost agree/agree) that the game helped to identify waste in health care processes (Fig. 4). In the questionnaire were four options to answer: 1=disagree, 2=slightly agree, 3=almost agree and 4=agree. Therefore, the scale was not linear.

2.3 Discussion

According the studies, assessing digital game based learning is relatively new topic. Although research on games has been carried out across the globe, there are no distinctive guidelines and best practices in this field [19]. This pilot study was concentrated in participants' instant experiences. Pedagogic influence as well effects on long-term memory were not under scrutiny. It would have been interesting to discuss with the participants after about how much "Lean Game" provoked thoughts and discussions about Lean Philosophy. In addition, it would have been very beneficial to have possibility to study whether the game influenced participants to make chances in their work in practice. Nevertheless, that would have needed a follow-up study and resources lacked this time.

There are several limitations in this study. Arrangements between participants in Emergency Medical Service and Radiology Units were different. Staff working in Emergency Unit played "LeanGame" during their workday and according the results, they often had to stop their playing due to the nature of their work. At the same time, study group working in Radiology Unit had a separate playing session without interruptions. The response rate in Radiology Unit (100 %) was significantly better than in the Emergency Unit (28.8 %). There also was a similar trend in results between these two groups; the participants in Radiology unit assessed the game slightly more positively compared to the other group. The idea behind playing during worktime was that "LeanGame" would became an educational tool that can be used whenever the employer has time, more than once. However, having spare time is a challenge in the hospital environment.

There was a need for organization's research permission in this study. Permission was needed, because the participants used their working time during it. This pilot study was conducted as a part of student's master of health care thesis and it did not benefit the researchers financially.

2.4 Conclusion

Lean is a quite new concept in Finnish health care system [20]. The District of Southwest Finland has decided to implement Lean Philosophy to all organization levels. Training all employers is critical for that kind of cultural chance [21] as well as need to change management system and leadership approaches in order to achieve as much benefits as planned from change. Lean is a wide concept and impossible to grasp entirely trough games. It has to be remembered that digital game is still a learning platform or which provides content such as videos, books or any other, even that it is very distinctive one compared to others. Digital or manual, games still involve participants and enable them to test Lean tools in a safe environment.

The "LeanGame's" designers' goal was to create an educational tool, which is easy to use, provokes thoughts and fosters discussion about Lean [22]. According the results in this study, they did succeed. "LeanGame" was found to serve as a complementary way to achieve the basic lean training goals in health care organization. The Hospital District of Southwest Finland has decided to adopt "LeanGame" to be part of its education strategy to be one of the first contact in Lean education.

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