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Smart Solutions for Wellbeing Service Development and Management

– Rethinking the Future 4.0

Leinonen Rauni, Moisanen Kirsi, Würfel, Alexander (ed.)

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Foreword

The Smart Solutions for Wellbeing Service Development and Management (5 credits) course was organised for the fifth time in the academic year 2021–2022 in cooperation with teachers from Kajaani University of Applied Sciences and Neu-Ulm University of Applied Sciences.

The studies started online in November 2021 and continued with the Kajaani University of Applied Science International Week in February 2022. The theme of the online week was *Rethinking the Future*. During the International Week, expert lectures focused on the future and future technological innovations. The expert lectures covered topics such as the 24/7 life management and mystery game for young people, bot applications based on service design, the development of a national innovation ecosystem for well-being and health data, virtual reality technology and the challenges of health and social care in sparsely populated areas, not forgetting the digital innovations that the students designed and presented during the week. Most of the student innovations this time were related to monitoring the well-being of social and health care workers.

Working practices and processes have become digital, and the use of technology has enabled employees to modernise their work. At the same time, digitalisation and technological solutions have led to complex work environments where the proliferation of information and communication channels exceeds workers' capacity to manage and undermines well-being at work. Digitalisation is changing the culture of work and learning.

Well-being at work is a complex issue. Meaningful work contributes to a worker's well-being. Well-being at work is linked to the worker's life situation, social support network or lack of it, hobbies, recovery methods, sleep and health, among other factors. New, innovative solutions for assessing well-being at work are needed to address the evolving challenges of well-being at work and work capacity problems. The well-being benefits of technology and digital applications include accessibility, interactivity and customisation. The applications make it possible for anyone to monitor and manage their own well-being at work. Interest in maintaining well-being at work through various applications has become more widespread.

Learning together is an opportunity to develop skills as work and technology change. At the heart of learning and teaching are people and multi-actor collaboration. The course as a whole was designed to combine collaboration and interaction through digital and face-to-face encounters. After the International Week in Finland, studies continued with student networking meetings and

the second International Week, which took place in Neu-Ulm, Germany. The physical International Week allowed student teams to participate in interactive and close-contact co-development. Students deepen their knowledge by learning about multi-form projects and marketing innovation

The changing world is also reflected in teaching and learning. Teachers are also interpreters and coaches for students, so there is a need to keep up with the times and be ready for change. Perhaps the purpose of this course may also in future be "*Rethinking the Future*", in other words support for collective and individual perspectives.

Kajaani, 5 November 2022

Rauni Leinonen, Kirsi Moisanen and Aleksander Würfel

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1 Smart Solutions in wellbeing – rethinking the future: an interdisciplinary project as a virtual cooperation

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1.1 Background

Especially as the Covid-19 pandemic subsides, it is currently becoming clear how the situation of recent years has shaped the perception of existing challenges and opportunities in the context of digitization. The mandatory use of digital solutions, the challenging working conditions in the healthcare sector, but also the effects on social relationships have left their mark. Established solutions are being re-examined and as well new aspects of digitization are being perceived. The intense use of information and communication technologies during the Covid-19 pandemic, can be seen as a crash course and provide a new perspective on future processes and working environments in the healthcare sector. Opportunities and risks were forced transferred from the theoretical discourse into practice and thus became immediately tangible. This year's mission statement for the course, “rethinking the future”, therefore seems very appropriate

Already in the early phase of the pandemic, it became clear that social aspects in everyday work are gaining new importance when the use of digital ICT increases. Work-related stress is shifting and changing. Fields of work that are already before strongly characterized by communicative exchange experienced an almost complete shift of communication and interaction into virtual space. E-mail and video conferences replaced the "conversation in the hallway". In return, casual communication among colleagues, which mainly took place in attendance, was greatly reduced. Accessibility was made easier by video conferences or e-mail. At the same time, the ubiquitous communication also made private and professional areas of communication less selective. If the presence at work allowed a clear localization of the communicational framework, then in digital work environments there are much stronger mixed communication worlds. There are already many findings to the existing impact, especially on young people, due to communicative stress caused by the so-called social media. Digitization can lead to an additional stress here. (Rau 2017; Gimpel et al. 2020.)

The fact that restricted communication channels (e.g. video conference, e-mail) have an impact on social relationships quickly became clear in the forced switch to home office and e-learning. As an option for future collaborations, virtual environments are increasingly seen as a chance to make actors more visible. At the same time, there are new opportunities for ubiquitous collaboration, since virtual environments offer a different scope than purely communicative exchanges via video conference. The actors can “create” something together or “experience” situations (Erickson-Davis et al. 2021).

At the same time, the changes also led to new or changed workloads for employees. Healthcare workers in particular were exposed to enormous workloads. Last but not least, the intensification of work led to greater physical and mental stress in many areas (Bohlken et al. 2020).

The cooperative subject "Smart Solutions in Wellbeing" of the universities in Kajaani (KAMK) and the University of Neu-Ulm (HNU) has existed since 2017. The basic idea is to develop practice-oriented and innovative digital solutions. The last few years have made it abundantly clear what potential arises from digitization in a wide variety of areas.

It has already been shown that the starting points of the projects can also be seen in the context of the given framework conditions. Already in the last, virtually implemented project, some projects went into the opportunities and limits of digital technologies. This was also reflected in the current projects.

1.2 Methods

Since 2017, students have been developing innovative projects in the context of "Smart Solutions in Wellbeing" as part of a cooperative course at the University of Applied Sciences in Kajaani (KAMK) and the University of Applied Sciences in Neu-Ulm (HNU). In the first two projects, in the years 2017/18 and 2018/19, there were students involved of the Master of Social and Health Care and Bachelor of Engineering (information and communication engineering) courses at KAMK as well as students of the Business Administration and Bachelor courses Health Management and Health Information Management from Neu-Ulm.

In 2021, the cooperation could only take place virtually. Students of the Master of Social and Health Care course at KAMK and students of the Bachelor courses in Business Administration and Health Management from Neu-Ulm were involved. The start of the course was the 2021 virtual

International Week at KAMK in Kajaani. Unlike in previous collaborations, the 2021 lecture was limited to one semester (March to June 2021).

The project in 2021 made it particularly clear what impact the exclusively virtual communication of the participating students and professors has on the development of the project ideas. Since a physical meeting of the students was not planned, problems had to be solved in video conferences or via email.

Nevertheless, the experiences encouraged those responsible to plan and implement an event in 2021/2022, despite the continued uncertain overall situation. Once again, students from the Master of Social and Health Care course at KAMK were there, developing and introducing the initial project ideas. From the Neu-Ulm side, students of the new Masters in Digital Health Management were involved for the first time.

The course started with a virtual "kick off" event in November 2021. During this event, the Finnish students presented their ideas and the students formed teams. In addition, the students received ideas for the development of their innovations in impulse workshops. Moreover, some techniques in project management were presented, which the students should implement in their projects.

From November 2021 to February 2021, the course was supported by blended learning and included two presentation workshops for the German students. In the first workshop, the students presented their agreed final project idea and showed how they will approach the further implementation of the project in the coming months. For this purpose, a work breakdown structure for the project, milestones and work packages had to be created. In the second workshop in January 2022, the students presented their final innovation idea.

A final presentation as part of the International Week 2022 at KAMK was planned as the end point of the first project phase. Unfortunately, due to the pandemic, the trip to Kajaani had to be canceled at short notice and the International Week took place only virtually again. Nevertheless, the students presented the final innovations and worked out the timeline for writing the article. In the following summer semester, the participating students were able to work out the innovations in a scientific article.

A first draft of the article was to be submitted in early May. The final workshops for the article were implemented as an international week in attendance at the Neu-Ulm University of Applied Sciences. This also gave the students the opportunity to further reflect on their innovations in the

Innovation Space of the University of Applied Sciences Neu-Ulm. In so-called design sprints, the students also considered the marketability of the innovations. The integration of the innovation space should also serve to bring the idea of entrepreneurship more into the focus of the students.

Accompanying the project, the lecturers provided coaching according to the needs of the individual groups. This coaching included both technical and team-oriented content. The interdisciplinary and intercultural cooperation was made considerably more difficult by the largely virtual communication. While in the past cooperations in the "on site" phases in Kajaani an interactive group discussion was possible and many problems could be solved, this had to be substituted in the given framework conditions. Overall, however, the cooperation worked well. As a result, the students developed innovations with very high practical relevance in interdisciplinary approaches.

1.3 Results

As in previous collaborations, the teams applied their innovations to real problems. This leads to a certain characterization of the projects by the specific Finnish framework conditions. Nevertheless, similar to previous collaborations, the interdisciplinary and international collaboration resulted in a profitable generalization of the problems. In the present project in particular, there was also an extremely high degree of openness, since the initial ideas provided more of a sketch and the innovations were then further developed in a cooperative manner. It was precisely through this joint work that the innovations received a high degree of transferability to other contexts of use. In many aspects, the innovations reflect the developments of the Covid period. The following projects were processed.

Only one innovation can be located in the field of relatively conventional digital solutions in the context of healthcare. The initial idea was to develop smart shoes with a location sensor to track people with dementia. The main idea was to ensure patient safety by making it easier to find them in an emergency. Since corresponding technical solutions already exist, the student team developed the innovation as a holistic solution. The built-in sensors can provide valuable data on the movement behaviour of the patient in diagnostics. For doctors, this gives information about the medication on the one hand and the progress of the disease on the other. In addition, the students outlined possible forms of data storage and transmission. Realizing this innovation, it

has to be assumed that the corresponding patients are not able to start a data transfer for example. It is therefore particularly important to ensure that the data collected can be easily transferred. Automated solutions are essential here that require as little effort as possible by the patient or his relatives. Loading the shoes was also part of this problem.

Two projects dealt with stress in the everyday work of nursing staff. Both projects are conceptually close to the experienced effects of the pandemic. One project focused in particular on the psychological stress that occurs in everyday work and how employees deal with this stress. The basic idea was to document perceived stress or moods. This could help employees primarily to make their stress-level or moods transparent for themselves. The developed "Vibe Tracker" (Sensscale) aims to strengthen job satisfaction through continuous monitoring of psychological stress through better self-awareness and emotional intelligence. The idea takes up existing approaches from the field of so-called self-measurement, which, however, primarily focuses on vital parameters or activity measurements. The challenge was to capture the mood of the employees through short questions. In addition to use by the employees themselves, a use of the aggregated data for the human resources management was also considered. The collected data could provide valuable starting points for measures in company health management. Data protection and security play a special role in this innovation and are integrated in the final innovation.

A second innovation also starts with stress on employees, but focuses more on the area of physical stress. The initial idea of the innovation was, among other things, to use everyday work in the sense of fitness training. Fields of activity in the healthcare sector are usually associated with high physical stress. To understand the everyday ways not only as a burden, but also as part of a fitness training can have a motivating character. In addition, the collected data could show to one-sided physical stress. This possibly provides starting points for additional trainings. Here, innovation bridges the work-life gap. Within the framework of the innovation, there was a major problem in the realizable monitoring of the activities. Hygiene regulations in health care enviroments make it difficult to use conventional fitness trackers. As part of the data collection, challenges or comparisons within or between institutions were also considered. In addition, as with the innovation outlined above, the collected data can provide valuable starting points for company health management. The processing of the data in form of a Smart Phone App can simultaneously form a communication channel.

Two further innovations anticipated the concept of so-called "serious games" approaches or virtual environments. Both innovations pursued an educational objective, but were very different in

terms of orientation and objectives. At the same time, they show the enormous range of possibilities given through virtual environments.

One innovation deals with emergency training, which is usually implemented today as part of on-site training courses. The special focus was on emergencies in the operating room. The innovation moved this training to virtual space. In simulated emergencies, employees had to keep their bearings and make the right decisions. The innovation incorporates the real surroundings of the employees. As part of the innovation, the students also created sample videos that clearly illustrated scenarios. By means of the simulation, easier access to training was created and the premises on site do not have to be used. Accordingly, virtual training allowed a significantly higher training frequency and simulations that are more comprehensive. The focus on surgical emergencies chosen as part of the innovation would be easily scalable to other scenarios.

The second innovation, which is located in virtual environments, deals with a completely different topic. Somewhat generalized, the innovation focuses on the education and training of employees' social skills. In community training sessions, employees can learn reaction patterns in certain situations in virtual environments. The interaction with colleagues as well as the interaction with patients can be simulated virtually. The innovation follows the gaming approach, used also in so-called serious games. This means that, for example, stressful situations can be experienced in virtual rooms, and active coping strategies can be tried out. As in the innovation described above, the students worked out different scenarios using videos as examples.

1.4 Discussion

The innovations deal in many areas with the everyday work of employees in the healthcare sector. On the one hand, specific workloads are discussed. An attempt is made to find starting points for overcoming the specific requirements via objectification. On the other hand, trainings on everyday situations or emergencies are made ubiquitously usable as serious games for employees.

The latter approach appears to be a very plausible application of serious games in everyday working life. Dealing with critical situations, be it stressful situations or emergencies, can be trained more frequently and reaction patterns can be better internalized. At the same time, it should be noted, especially with the latter applications in virtual space, that this ultimately also leads to a reduction in social contacts. If the actors train emergencies in virtual space, the situation itself is static. In a real training with several employees, mutual reactions can influence the individual's

ability to act. In virtual space, this would only be conceivable if several participants used it at the same time. The latter is therefore certainly a sensible scenario, but at the same time reduces the ubiquitous usability of the application, since the training would have to be coordinated in terms of time. However, individual training of the individual employees in virtual environments can also encourage alienation tendencies. Ultimately, the interaction could lead to action schemes instead of individual reactions.

Overall, the innovations once again show the potential of interdisciplinary cooperation. In addition, it becomes clear to what extent the framework conditions of recent years have influenced the orientation of innovations. While the innovations in earlier projects (before Covid-19) primarily focussed on medical applications, the more recent innovations are increasingly aim for the working environment itself.

The project was originally supposed to start with a presence phase in Neu-Ulm in December 2021. However, it was already clear in the initial planning that this would be impossible due to the Covid situation. Especially for the first phase, presence for team building and the first differentiation of the innovation would have been very good. Due to the pandemic, the kick-off took place virtually and the focus was on completing the first phase as part of the International Week in Kajaani in February 2022.

Unfortunately, the project as a whole had to be implemented virtually to a much greater degree than originally planned. An International Week in Finland would have been good for the teams and could have given the cooperation a different intensity. The redesign made some of the teams' planning more difficult. In large parts, the division of the work packages resulted in a good individual work organization, which also took into account the different context factors of the students involved (employed, full-time student).

Overall, the participating students from Finland and Germany did a very good job and developed well-defined innovations. After the end of the International Week in Neu-Ulm, it became clear once again how important presence is for cooperation and creativity.

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2 A serious game for communication training: Com.Unicate.Training (C.U.T.)

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Abstract

In this article, the innovation idea of the communication skills training tool "Com.Unicate.Training (C.U.T.)" is presented. The purpose of this article is to describe how communication skills are influencing the wellbeing of healthcare workers at their workplace. It is based on the concept of serious games and was developed with the purpose of helping the users to learn how to communicate in an appropriate way. Therefore, this game is intended to improve the teamwork, reduce the stress level of the employees and accordingly decrease the number of sick leaves. For that reason, this smart solution aims to have a positive impact on wellbeing at work and overall job satisfaction. The AI-based innovative training tool C.U.T. is presented on the basis of a prototype created within a use case of nurses from a hospital in Finland. It should be emphasized that the game is scalable and that a transfer of the C.U.T. to areas other than hospitals, for example to the entire healthcare sector, and beyond that to other industries, is conceivable. Especially the healthcare sector is confronted with major challenges which reduce wellbeing at work due to demographic change and its effects. C.U.T. can also help here.

Keywords: Smart solutions, AI, communication skills training, wellbeing, serious games, healthcare sector.

2.1 Current situation of wellbeing at work in the healthcare sector

This article describe how communication skills influence wellbeing at work. Therefore, it explains how organizations can improve their work environment by using the innovative serious game Com.Unicate.Training (C.U.T.) that helps the employees to develop better communication skills. The game gives the employees the opportunity to try out the strategies that they learn in a safe environment without having to fear negative consequences. Therefore, the aim of this article is to show a new starting point for companies, especially in the health sector, to improve existing working conditions. Instead of solely focusing on conventional conditions like flexible working hours or financial incentives, they should additionally consider the communication between the members of the team and all members of the organization.

Underlying challenge for the hospital at Kainuu Association of Social and Health Care Joint Authority

The Finish team member of this innovation team, Piipponen, works at the Kainuu Association of Social and Health Care Joint Authority (Kainuu sote) and has been involved in developing work community skills at her workplace. The Kainuun sote provides primary and specialist healthcare services, social care services and care-related support services employing approximately 3,800 employees. (Kainuun sote 2022b; Kainuun sote 2019, 22). The organization has an ongoing project called “From data on wellbeing at work and productivity”. During the project, there will be an occupational wellbeing survey using the Quality of Working Life Index (QWL) (Kainuun sote 2022a). The QWL transformed from an indicator of wellbeing at work to a factor of productivity and is approved by the international scientific community. It explains the link between wellbeing at work and productivity (Kesti 2017, 50).

In Kainuun's third occupational wellbeing survey in November 2021, the QWL was at 53, 8 %, which is less than in the previous year. Based on the study presented above and the increasing values of the QWL, the staff development strategy follows the goal to gradually improve the QWL up to 60 % (Tiedosta sanomat 2021).

Wellbeing at work

There are several factors that affect wellbeing at work. Among other things, it includes work environment and work community skills (Kauhanen 2016, 28). The current trend of the change in management roles points to the growing importance of soft skills as well as communication and team skills. Peer-to-peer communication and the promotion of employee participation have become key success factors (Hirsch-Kreinsen & Wienzek 2019, 26). In a work community, good communication is expressed in successful interactions (Puusa & Ala-Kortesmaa 2019, 196). System theory defines communication as an exchange of information. An essential pre-requisite for this exchange is an existing interest in information on the part of the participants. Thus, it is essential that the recipient of information asks questions in order to gain the right understanding about the information. For the sender of the information, the willingness to communicate and answer the questions is a prerequisite (Jiranek & Erdmüller 2021, 38-39).

2.2 The meaning of communication in the healthcare sector

Regarding the demographic change, there is a smaller workforce available in general. On the other hand, there is an increasing demand for healthcare services as the population is tending to age more and therefore suffer from multimorbidity (Runde, Da-Cruz & Schwegel 2012, 2-3). The healthcare systems in many countries around the world are under the pressure of the demographic change. The forecast for the proportion of people in need of care in the working-age population shows an corresponding trend in several regions of the world from 2010 to 2050 (Alzheimer's Disease International 2013, n. p). The World Health Organization (2020, xiii) reported that a 5.9-million global shortage of nurses is estimated for 2018 and as one of its goals calls for massive investment in the healthcare workforce and caregivers. Thus, this argument can also be listed in the analysis under the following sub-item as a positive aspect since governments worldwide are trying to remedy this issue.

In Germany, in 2018, 9.3 % (730,000 jobs) of a total of 7.83 million job vacancies were in the healthcare sector (Textkernel 2019). In addition, the high proportion (16 %) of sickness notifications due to mental illness, e.g. burnout, is a striking feature of the healthcare sector (Meyer, Maisuradze & Schenkel 2019, 457-462). In Finland, the incapacity for work pension has increased in recent years, which is explained by the change in the age structure of employees. Pessimistic

estimates are being driven by the number of disability retirements in the group of health professions. Additionally, by 2035, 51 % of the labor force will have retired in the area of health services (Tevameri 2021, 65-70).

These conditions bring significant challenges to the nursing field, and subsequently to the health care system. The intensity of work and thus the stress and work pressure for nursing professionals have increased over the last years. Nurses are confronted with time pressure and rush more often than employees in other professions, thus feeling overworked more frequently and in some cases exceeding their limits. If the required work cannot be done due to inadequate staffing, the result is an overload of work and increased stress on the nursing staff. As a result, the risk of illness can increase. For the individual nurse, this development can reduce motivation and the ability to continue working in the nursing profession. Increased absenteeism or even resignations from the profession then lead to an increase in the workload for the remaining nursing staff. This vicious circle must be broken to assure the quality of nursing care. Dissatisfaction arises e. g. from a lack of recognition of the nursing activity or from far more significant conflicts with patients, clients or relatives (Rothgang, Müller & Preuß 2020, 137, 155-157).

In social professions in particular, it is clear that employees have a strong desire to contribute to the common good and help people (Bass & Riggio 2006, 32-34). This so-called intrinsic motivation is considered a key success factor for good work performance (Bass & Riggio 2006, 6). When caregivers can no longer fulfill these requirements due to the circumstances described above, psychological overload is an obvious consequence.

Studies emphasize that employee sick leaves can be reduced through a high quality of work and a high level of job satisfaction (Lutze, Trauzettel, Busch-Heizmann & Bovenschulte 2021, 124). A positive error culture and recognition of individual ways of thinking stimulate employees to accept problems as challenges and to view them from a solution-oriented perspective. This could be reached through Transformational Leadership (Bass & Riggio 2006, 6-7). It has also been proven that companies with a positive leadership culture and constructive communication culture are characterized by low employee turnover and thus also radiate stability even in times of crisis or change processes (Fakundiny 2013, 68-69). Best practices are so called Magnet Hospitals, which are hospitals that include good communication in their corporate concept (American Nurses Association n. d). It became clear that interactive work that is important in nursing practice benefits from open communication culture (Lutze et al. 2021, 134).

On a superordinate level, the quality of work is based on the experience of coherence in everyday work. To improve the working conditions in nursing, thus promoting the health of nursing staff and making the nursing profession more attractive, it is necessary to evaluate the existing work requirements and the means and characteristics available to a person to cope with the requirements, e.g. work resources (Lutze et al. 2021, 19-20). As listed above, a positive workplace environment is conducive to this and is based on good communication. This is exactly where the innovative C.U.T. solution strategy comes in and can influence the negative circle into a positive one, which is based on a good working community. The solution strategy of the innovative C.U.T. is shown in figure 1.

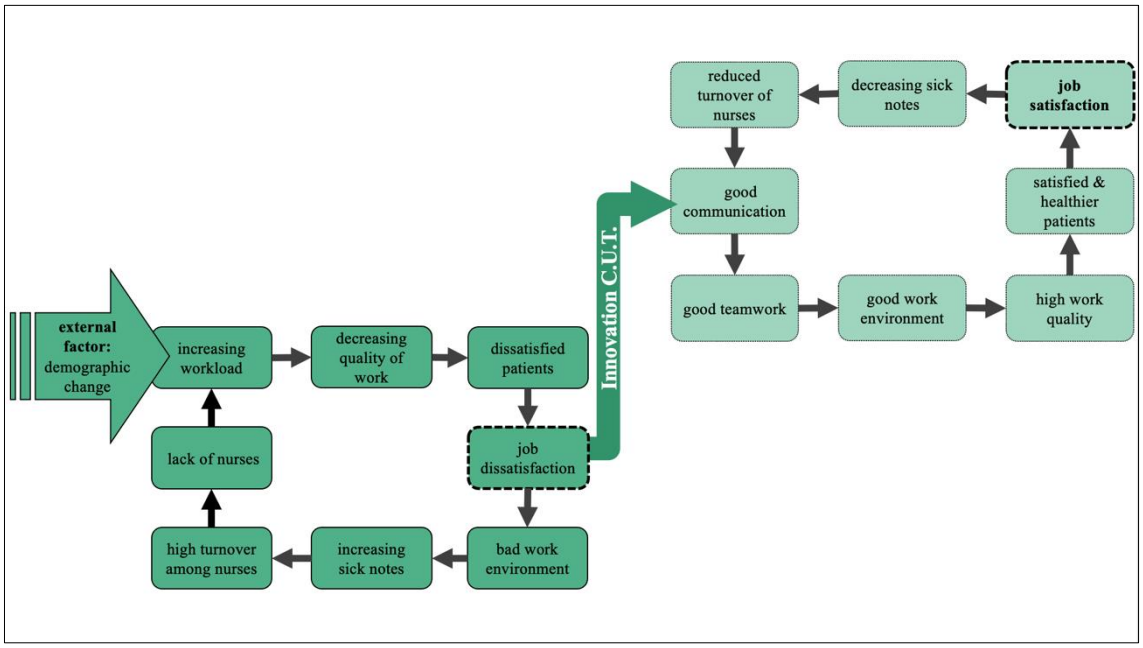

Figure 1. C.U.T. solution strategy (Authors` own illustration 2022)

Further fields of application

As already described, the innovation C.U.T. could be used within the framework of the Kainuun sote and is scalable to the complete health care sector. In the context of the described high psychological stress of the work situation in the health care sector, the C.U.T. could also serve as a mental-support training, because communication is a key success factor in this area as well. In the future, this factor will play an increasing role in interdisciplinary and cross-sector patient care as well as in the direct treatment and care of patients and their relatives (talking medicine). Doctor-patient communication is an ancient form of the art of healing, which originally took a central role as a therapeutic approach (Schneider 2022a). Studies have shown that words can have a high

treatment effect in certain areas of patient care (Schneider 2022b). Since 2020, this approach has been increasingly reflected in the billing catalogue for medical treatment (in Germany), thus improving its refundability in the context of treatment (KBV 2019). Because of this, it makes sense to implement general communication training in the education of healthcare employees.

Furthermore, all possible areas of application and sectors are conceivable. As the innovation is based on Artificial Intelligence (AI) and therefore can be customized, it can be used everywhere, where communication is involved. It is also imaginable to use the tool to recognize certain leadership types, talents or simply certain strengths of individual persons in order to promote and use them in a target-oriented manner, such as a talent scout game. It is also conceivable that the algorithm could be integrated into other gamification tools for children or young people. The areas of application are therefore extremely broad and hold enormous potential.

2.3 Description of the innovation and its prototype

In this chapter, the underlying idea for the innovation is described. After that, the developed prototype is presented. The main inspiration for the innovation came from the InnoSÜD sub-project "Sales Lab" (Barsch 2020) of the University of Applied Sciences in Neu-Ulm. The project is about a virtual negotiation training, where the player has to try to beat the so-called bot, based on AI, which reacts to what the player says. This simulation can be used e.g. for trainings in sales management (HNU 2020).

Because the initial idea for the innovation was to find a new approach to train employees in their work community skills with a focus on their sales skills, the strategy of the Sales Lab seemed to be a good base. The innovation team wanted to concentrate on finding a new format for the communication trainings, giving the employees the opportunity to test out the strategies that they learn in a safe environment without having to fear negative consequences.

Therefore, and with the Sales Lab in mind, the project team decided to develop a serious game. There are various definitions of this term available, but generally speaking, a serious game can be defined as follows: "[…] serious games are (digital) games used for purposes other than mere entertainment". These other purposes can for example be related to training, advertising efforts, simulations or education (Susi, Johannesson & Backlund 2007, 1, 3). The concept of serious games is based on the perception that the motivating and engaging aspects of video games can be used to make learning in other areas more enjoyable and effective (Marsh 2011, 61).

The Com.Unicate.Training is supposed to make use of these benefits. It works like an interactive training game that enables the player to improve their communication skills by putting him (virtually) in different kinds of conflict situations where they have to make a decision. This means that in this situation-based training approach, the choices of the player directly affect the ongoing story. To elevate the gaming experience and increase the impact on improving the users' communication skills, the game is developed based on AI.

In the purest sense of the term, AI is a software that mimics human intelligence and therefore is supposed to recognize patterns from data sets, build knowledge from these patterns and make 'intelligent' decisions (Jörg 2018, 87). Through the usage of intelligent algorithms, the in-game world and its characters can react authentically to the players' actions. It is simulating intelligent behavior that would be expected from a real human while adapting their actions to the decisions of the human player (Steinbach & Schulz 2019, 2). For the communication skills training game, this means that the player can make decisions on his in-game behavior regarding the underlying conflict situation. The algorithm that is used to develop the game will ensure that the other characters react individually to it.

To be able to provide the audience with a usable first presentation of the innovation idea, the team decided to create and develop a prototype.

This prototype consists of two parts: the mockup of the desktop application (app) of the serious game and the interactive animated videos that create the option for the user to decide how the story should go on. The project team created a mockup to visualize the design concept of the innovation and include basic functionalities. A mockup is a draft of a website or app. (Ryte 2021.) The result is an interactive prototype which is oulined through screenshots in figures 2-5 below. Figure 2 shows the login page of the prototype.

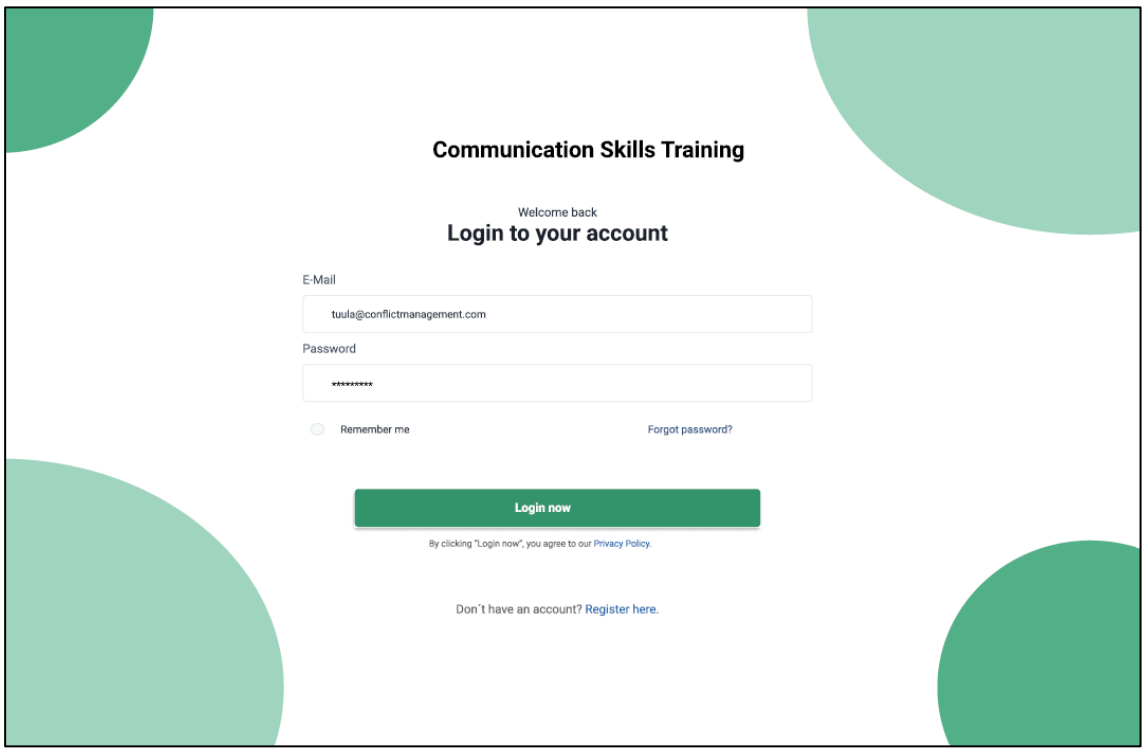

Figure 2. Mockup of the C.U.T. (part 1) (Authors' own illustration 2022)

The next figure (figure 3) shows the menu, where the user can choose between the four segments categories, training history, settings and further information.

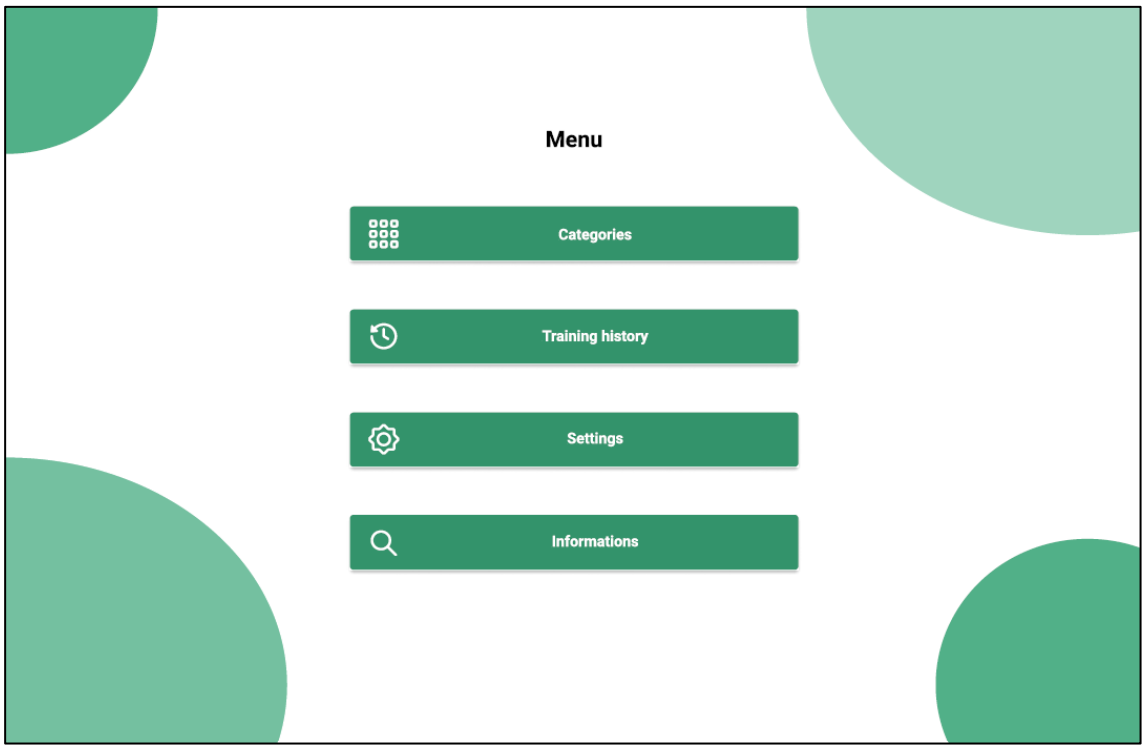

Figure 3. Mockup of the C.U.T. (part 2) (Authors' own illustration 2022)

If the users click on “categories”, they see a selection of training units (figure 4). Here, the user can start a communication training-session related to a specific topic. These categories include different areas that are important in terms of communication skills. It is important to mention that these categories are suggestions of the innovation team that could be changed by the organization that is using the C.U.T. game.

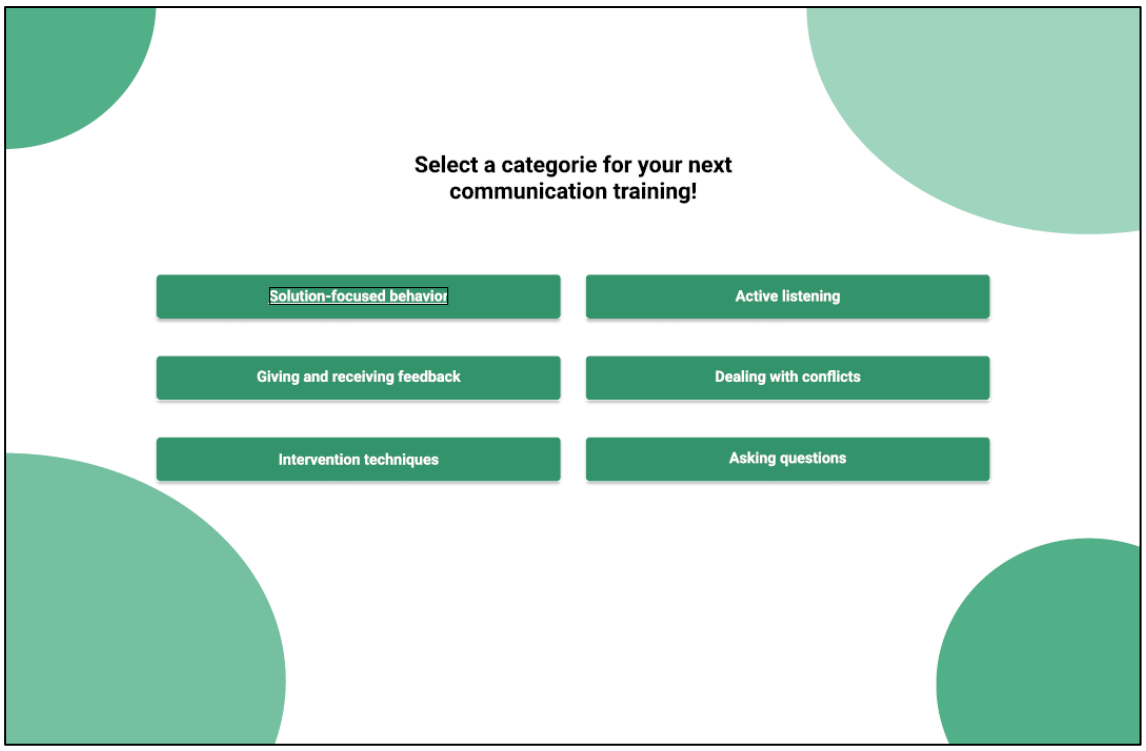

Figure 4. Mockup of the C.U.T. (part 3) (Authors’ own illustration 2022)

The last figure of the mockup (figure 5) outlines a possible screen that could occur when the user has successfully finished a training. This version gives the user the opportunity to open a file with detailed feedback, download a certificate or go back to the menu to start another training-session.

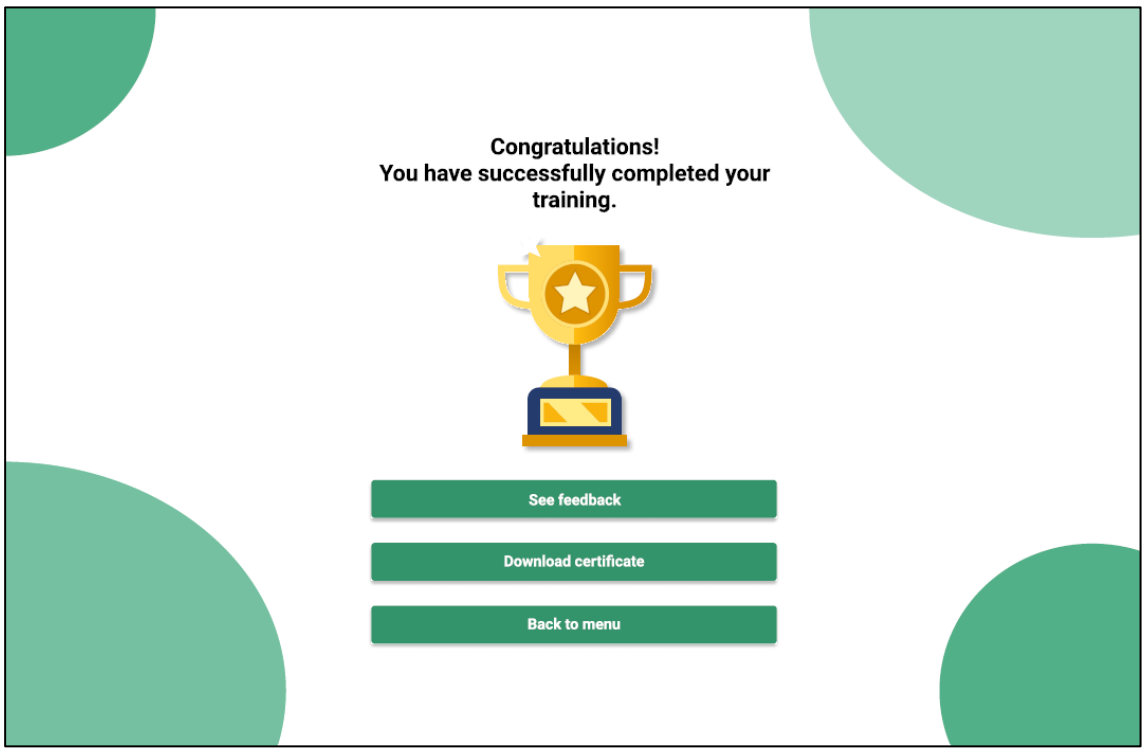

Figure 5. Mockup of the C.U.T. (part 4) (Authors' own illustration 2022)

To fill this mockup with content, the innovation team focused on one exemplary conflict scenario and created animated videos for it. These videos were uploaded to a video platform so that they serve as one interactive story, where the user can decide between two options how the story continues. These videos can be reached by selecting the category "solution-focused behavior" in the mockup shown in figure 4.

The created prototype illustrates the underlying idea of the communication skills training while being cost-and time-efficient throughout the development. As well as that, the innovation group was able to conduct the design and creation of it themselves, without the need to consult a programmer. However, this would be necessary to develop the real serious game at a later stage of the project.

2.4 Unique Selling Point of the innovation

The unique selling point (USP) in the commercial sense presents the unique benefits of the company's own offering and thus sets it apart from other competing offerings. This encourages consumers to buy, especially in case of market saturation and possible substitution (Markgraf & Esch 2018). In the social business sector, the USP addresses both customers and beneficiaries (SEND

2018, 21-23). The intended added value for the target group generates value for the society. Social innovations thus set the course for systemic social change (Portales 2019, 6). The primary goal of social business is to solve social challenges through a business approach (SEND 2018, 26). The C.U.T. focuses on achieving a positive impact on the problem of the care sector. Profit-making aims are also to be pursued, but are not the primary goal.

In comparison with traditional communication training methods like workshops or seminars, the innovative approach of the project team offers the participants the possibility of trying out the knowledge and techniques they learned within the serious game. Due the peculiarities of a game, they can apply the knowledge in the virtual environment as often as they want and without the fear of negative consequences in the real world. Possible negative consequences could as well be that if traditional trainings use role plays, the people who take on the misbehaving characters can afterwards be perceived in a negative way in reality. Additionally, personal dislikes or prejudices against colleagues, which can be found in every work environment, are not reproduced or reinforced by the Com.Unicate.Training. This influence is given in traditional role-plays. Due to this, the scenarios in the game can be exaggerated to reinforce learning effects and illustrate examples. This is a significant component of the USP.

In addition, the communication skills training game will have the option of creating certificates for the employees who finished the training session with good results, to motivate them to participate. Moreover, the innovation has financial advantages compared to traditional training. For the game, only the participant needs to take time to attend the training, whereas for the role plays, several people have to take part at the same time, which is especially problematic in the healthcare sector due to the shortage of nurses and doctors. The game, in contrast, leads to a notable cost reduction. Other than that, a specific feature of the C.U.T. is that there is going to be the chance for the companies that want to use the game for their employees, to include customized user stories and scenarios. This allows the game to teach the employees about company-specific situations and how they should behave in these unique scenarios. This level of individual customizability is another important element of the USP.

In summary, the USP of the communication skills game mainly consists of three parts: due to its game character, the theoretical knowledge can be tested as often as the player feels the need to do so and the scenarios can be exaggerated without having negative consequences for the participants, which is a significant advantage. This, and the fact that the companies using the game can implement their own scenarios to customize it and still save costs, makes the innovation unique and highly beneficial for the companies.

2.5 Conclusion

This article aims to change the approach of organizations especially in the healthcare sector to improve their work environment. Therefore, this chapter gives an outlook on the possible meaning that the communication training game can generate if it is successfully adopted by the market. In work environments where teamwork is required, fewer errors occur than if the work were only done by individuals. Subsequently, the improvement of teamwork through training leads to a reduction of error risk. Accordingly, a high error rate indicates for dysfunctional or absent teamwork (Lerner, Magrane & Friedman 2009, 318).

In addition, good communication skills among nurses increase patient satisfaction. Furthermore, an effective communication has a positive impact on patient compliance. The communication accommodation theory postulates that a good communication positively affects the behavior of individuals and groups. It is therefore presumed that communication has the power to increase the quality of health care and the output of teams, and improve wellbeing at work and in consequence the job satisfaction in the care sector (Haskard & DiMatteo 2009, 28-31). The article showed that by applying the innovative communication skills training tool C.U.T, job satisfaction could be enhanced. Thus, it can be stated that C.U.T. can contribute to the realization of the pursued goal of the Kainuun sote to gradually improve the QWL.

Moreover, if the C.U.T. were scaled and used in other hospitals and beyond that in the entire healthcare sector, it could achieve a positive impact on the described problematic situation of the healthcare sector and could change the approach of organizations to improve the work environment. Instead of only focusing on traditional internal measures, such as flexible working hours or financial incentives, they have an additional opportunity to sustainably improve the work environment. In this way, they contribute to a positive change in this major social challenge.

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3 "Vibe Tracker" (Sensscale) – an innovation to improve well-being in the workplace through self-awareness and emotional intelligence

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Abstract

Studies on working conditions show that hectivity in work is the most increased cause of disadvantage in the working environment and seems to have the most common and negative impact on healthcare employees. Healthcare workers are exhausted and no longer satisfied with their jobs. The Covid 19 pandemic has exacerbated this and made working conditions more difficult than before.

Identifying and appraising one's own emotions are related to higher subjective well-being. Perceptibility of own emotions and emotions of others are related to higher recovery experiences and higher work ability. Emotional skills help to improve emotional intelligence, and that significantly affects physical health and overall subjective well-being.

The purpose of this article is to describe how to develop employees' well-being by identifying their emotions with the innovation "Vibe Tracker". The aim is to promote job satisfaction and emotional intelligence in the healthcare sector. The "Vibe Tracker" is an application that can be used by all employees by tablet to indicate their own feelings and moods. This also gives the employer access to the emotional status of the employees. This the information on the mental status of the employees is aggregated and cannot be traced back to the individual level.

In this way, the innovation is intended to develop the working conditions and atmosphere and also promotes self-management among employees. This article discusses the literature on work-related stress and the meaning of emotional intelligence for well-being and how this innovation will be the key to a better and more balanced work environment in the healthcare sector. Following the illustration of the innovation, the article is rounded off by a market research study.

Keywords: Vibe Tracker, working conditions, well-being, healthcare professionals, self-awareness, emotional intelligence

3.1 Introduction

Well-being at work is often defined as physical fitness and maintaining and developing physical health as a supporting activity. However, well-being at work is also greatly affected by mental and psychosocial factors. These includes, for example, mental workload, individual experience in job management, relevance, atmosphere, and support from the work community (Pakka & Räty 2010, 6.) Previous research on working conditions in Finland focused on work-related hecticness and its negative effects in the 1970s, as well as on the fact that mental health problems among employees are becoming more prevalent. Feelings of helplessness, reluctance and fatigue, sleep disorders, tension, nervousness, and irritability, overwhelm and mental exhaustion at work were more common in 2018 than in 2013 (Sutela, Pärnänen & Keyriläinen 2019, 133, 311.) In Germany, almost two out of three people reported feeling stressed occasionally. This corresponds to 64 % (53.2 million people), meaning that more than half of the German population is regularly stressed. 26 % (21.6 million people) of the participants in a study carried out by the health insurance company Techniker Krankenkasse in 2021 reported that they were often stressed. The findings are not entirely new, even if an increasing trend can be observed. Already in 2013, 20 % (16 million people) of respondents said they were frequently stressed. This study highlights the significant increase of subjectively perceived stress compared to the last years. (Grobe & Bessel 2021, 89-90.)

In addition, absenteeism due to mental illness have clearly increased in recent years, especially among young and early middle-aged women in Finland. The number of people receiving sickness benefits based on mental disorders has increased by as much as 43% between 2016 and 2019 (Kelan tutkimusblogi 2020.) Emotional workload has significant links to impaired mental functioning and can result in burnout, particularly in the health care sector (Sutela et al. 2019, 133). Unfortunately, during the Covid-19 pandemic mental strain and mental trauma symptoms among healthcare professionals have more often appeared compared to before the pandemic (Laukkala, Tuisku, Junttila, Haravuori, Kujala, Haapa & Jylhä 2020).

According to the Digitalization Guidelines 2025 published by the Ministry of Social Affairs and Health of Finland (2016, 13), the goal is to ensure the well-being and health of employees with digitalization, as well as to prevent, reduce, and eliminate hazard and risks at work. According to Paganin's & Simbula's (2020, 699-700) systematic review of smartphone-based interventions for employees' well-being promotion, such approaches might help providing the skills to cope with and manage the stress and improving the general well-being.

The “Vibe Tracker” application was developed for employees to help them identify and analyze their own feelings and mental status. Research has found that identifying and appraising one’s own emotions is related to higher subjective well-being. Moreover appraisal of own emotions and emotions of others is related to better recovery experiences and higher work ability (Hintsa & Aronen 2021.) With the help of the “Vibe tracker”, employees can learn to identify their own feelings in order to improve their own well-being. The employer can also receive current and relevant data about the feelings of the staff and use the information to promote the well-being of the own team at work. The “Vibe Tracker” was developed to improve the well-being of the healthcare professionals, particularly by respecting the nature of their work. Therefore, the “Vibe tracker” is quick and easy to use by allowing to answer the questions with a mood scale. It further gives a statistical analysis for the user and some additional and supplementary clarification, with tips and help for everyday life (e.g., a quick breathing exercise).

The aim of this article is to promote job satisfaction and emotional intelligence in the healthcare sector. Furthermore, the purpose of this article is to describe how to increase employees’ well-being by identifying one’s emotions with the innovation of the “Vibe Tracker”. The introduction of the “Vibe Tracker” should present an opportunity to develop a digital innovation for healthcare professionals and to improve their well-being at work, as well as their overall working conditions.

3.2 Theoretical background

In the following, different topics on the background of the innovation are analyzed and presented. The future benefit of the “Vibe Tracker” will be explained based on background knowledge.

Well-being at work and working conditions

In all EU countries, employers have a statutory duty to take care of their employees. The obligation includes ensuring the physical, mental, and social health of the workers. EU legislation (Directive 89/391/EEC), for example, states that employers must take action to prevent various types of risks to workers’ health. Psychosocial risk management in the workplace is based on the principle of prevention in accordance with occupational health and safety laws. It seeks opportunities to eliminate or at least to reduce the risks to protect the workers’ health. A risk assessment tailored to a specific job and its tasks forms the basis for effective measures. (Tamminen & Solin

2014, 102-103.) Since 2013, it has been obligatory , e.g., in both Austria and Germany for employers to carry out evaluations or risk assessments of the psychological strain on employees (Preuner, Nöhammer & Katzdobler 2018, 7-13).

Research on working conditions have focused on the negative effects of hectivity in the workplace since the 1970s in Finland. The hectivity in work environments is the most significantly increased cause of disadvantage in the working environment. Studies on working conditions in 2018 show that hectivity seems to have the most common and negative impact on healthcare employees. Further studies conducted in Europe have focused on the intensity of work and results show a clear increase in work intensity in the past 15 years (Sutela et al. 2019, 133-134, 138.) Kersten's and Formazin's study (2022, 1-12) analyzed correlations between changes in working conditions and corresponding changes in the manifestation of burnout. In this study, the "Copenhagen Psychosocial Questionnaire" was applied, and results show that burnout depends on both the initial values of demands and resources, as well as their changes over time.

Many studies from all over the world show that the Covid-19 pandemic has a severe impact on the increasing stress levels and mental strain, particularly for employees in the health care sector (Ceri & Cicek 2021, 90; Mahgoub, Abdelrahman, Abdallah, Mohamed Ahmed, Omer, Abdelrahman & Salih 2021, 11; Britt, Shuffler, Pegram, Xoxakos, Rosopa, Hirsh & Jackson 2020, 144; Frenkel, Pollak, Schilling, Voigt, Fritzsching, Wrzus, Egger-Lampl, Merle, Weigand & Mohr 2022, 21). Recognizing the first symptoms can help to ensure both the work performance itself and the general ability to work. Electronic surveys for example could be used to assess personnel's well-being. Moreover, these surveys are suitable for guidance for support actions. (Laukkala et al. 2020.)

Stress and mental disorders in Germany

In the Federal Republic of Germany, 80% of the population suffered from stress in the past months. 91% of professionals in the health care sector suffer from stress and its effects. The Covid 19 pandemic has made working conditions even worse. As a result, the frequency of people experiencing stress has increased (31%) (Swiss Life 2022).

Stress can arise due to different and multiple factors and be present in a person's life. The stressors can be of different nature, depending on the work and working conditions (Statista Research Department 2022). The stress statistics show that 55% of respondents experience stress at work due to time pressure. Another important reason for stress is the large number of tasks (47%) and an unpleasant working atmosphere (37%). (Swiss Life 2022.) The consequences are physical and

especially mental illnesses and limitations, such as burnout, depression, or anxiety disorders (Statista Research Department 2022).

In 2019, 1.16 million people in Germany were in inpatient treatment due to mental or behavioral disorders (Radtke 2022a). In recent years, there has been a continuous increase in the number of days of incapacity to work (Radtke 2022b). Every fourth person becomes unable to work, and this is also associated with a risk of life-threatening consequences (Swiss Life 2022). The duration of the average sick leave in Germany in 2020 is 38.8 days, a recent historical record in this diagnosis group (Radtke 2022b). Strategies for dealing with stress differ from person to person. Of those affected, 27% have reported to use relaxation exercises to counteract experienced discomfort. About 23% try to alleviate stress with physical exercise. However, by no means all sufferers actively do something to combat everyday stress. Around one third (32%) does not take any measures to prevent or counteract stressful situations (Swiss Life 2022).

Particularly healthcare workers have been exposed to exceptional situations during the pandemic, which causes the stress level to increase extremely. "It will be a challenge for healthcare workers to remain mentally healthy in these rapidly evolving situations and reduce the risk of depression, anxiety, or burnout" (Vinkers et al. 2020). An online survey of nurses in intensive care hospitals during the second wave of the Covid-19 pandemic was conducted. Of 595 nurses, 47.6% had moderate to high levels of burnout, and 20.7% were considering changing jobs (Mata et al. 2021). 20% of the respondents stated that they were dissatisfied with the personnel management, in the context of the pandemic, duty scheduling and relief by sufficient professional and support staff were main features mentioned. A quarter of the respondents missed measures to recognize their achievements (Mai, Todisco, Schilder, Franke & Ristau 2021.) Nurses work in a permanent balancing act of meeting patient needs and nursing requirements in the context of insufficient resources and poor working conditions (Mai et al. 2021).

In summary, it can be stated that the studies show the negative effects of hectivity that affect the majority of health care professionals and their working conditions. The Covid-19 pandemic has worsened mental health and stress levels. It can be noted that emotional intelligence is one of the most important predictors of psychological distress and resilience. Different healthcare applications and technologies are a new way to take care of mental health. This market is growing with promising outcomes. The number of people with mental health issues or mental disorders are growing due to the Covid-19 pandemic in Germany. In the healthcare sector many professionals are overwhelmed and unsatisfied.

SDT-theory and emotional intelligence

According to SDT-theory (self-determination theory) people have three psychological basic needs which need to be satisfied to foster health and well-being. These psychological basic needs are autonomy, competence, and relatedness. SDT-theory states that the non-fulfillment of these basic needs is associated with less intrinsic motivation, more controlled regulation and motivation, and stronger extrinsic efforts, which lead to impaired experience, performance, and well-being. (Deci & Ryan 2000, 262-263.) The study by Bunce, Lonsdale, Childs and Bennie (2019, 2092, 2103), which focused on social workers in the UK and their high levels of burnout, pointed out the importance to understand how social workers can develop resilience to protect themselves from psychological distress. This study deals in depth with the understanding of the psychological predictors of resilience, which according to SDT-theory includes reflective ability, social competence, empathy, and emotional intelligence. The authors show that emotional intelligence was one of the most important predictors of both psychological distress and resilience. Being more emotionally intelligent was associated with being more resilient and experiencing less mental strain. (Bunce et al. 2019, 2092, 2103.)

Research findings illustrate that identifying and self-awareness of one's own emotions is related to higher subjective well-being. Appraisal of own emotions and emotions of others were related to higher recovery experiences and higher work ability. (Hintsa & Aronen 2021.) Emotional skills help to improve emotional intelligence, and that significantly affects physical health and overall subjective well-being. Emotional intelligence factors that have the strongest impact on health and well-being are self-esteem (ability to perceive, understand and accept yourself), self-actualization (ability to pursue personal goals and actualize your potential), stress tolerance (ability to effectively and constructively manage emotions), optimism (ability to be positive and hopeful) and happiness (ability to feel pleased with yourself, others, and life in general). (Reuven 2012, 41.) The study by Zeidner, Hadar, Matthews and Roberts (2013, 607) shows that emotionally intelligent practitioners can manage their coping resources more effectively and vulnerable practitioners may benefit from prevention programs that support effective coping, and constructive reappraisal, and regulation of the negative emotions of their own and others.

Welfare technology and questionnaires

Digitalization Guidelines 2025 published by the Ministry of Social Affairs and Health in Finland (2016, 13) defines that the goal is to ensure the well-being and health of employees with digitalization, as well as prevent, reduce, and eliminate hazard and risks at work. According to the publication, an artificial intelligence for example can improve existing forms of services and health information systems and particularly in the context of preventive measures, it could bring significant societal savings. Rantala, Keppo, Karadeniz, Hulkkonen and Karla (2019, 6, 22-23) point out that different mental health applications are also a new way to improve and take care of mental health. It is a growing and evolving market which has not been researched thoroughly so far, but according to current studies, they seem to be a promising tool to address mental health problems. These different applications and technological solutions have been developed to prevent mental disorders as well. Prevention can be implemented, e.g., by monitoring health behavior or with different self-help methods.

The participants of the study using the "myCompass" mobile application found that the tool helped them to reduce symptoms of stress, anxiety, depression, and overall psychological distress (Harrison, Proudfoot, Wee, Parker, Pavlovic & Manicavasagar 2011, 520). A review of 28 studies that use artificial intelligence to assess and analyze mental health to predict depression, schizophrenia or other mental illnesses shows that many algorithms are so sophisticated that they can accurately predict mental illness (Graham, Depp, Lee, Nebeker, Tu, Kim & Jeste 2019, 2-9).

Questionnaires are widely used throughout Europe. In Italy, for example, occupational stress is assessed by the "Perceived Occupational Stress (POS) Questionnaire". This tool has a very high internal consistency with a value of α=0.82 and is a reliable instrument for measuring stress. Furthermore, the POS scale uniquely contributes to the prediction of stress-related health complaints. (Marcatto, Di Blas, Luis, Festa & Ferrante 2021, 1-2.) Reliability, validity as well as objectivity (α=0.88) are given for the questionnaire "Satisfaction with Life Scale" (SWLS) (Janke & Glöckner-Rist 2012, 4-7). The SWLS is shown to have favorable psychometric properties including high temporal reliability and high internal consistency, and the scores correlate moderately to highly with other measures of subjective well-being (Diener, Emmons, Larsen & Griffin 2010). The "General Procrastination Questionnaire" (GPS scale) is also a reliable measuring instrument with a value of α=0.83-0.88, which relates to a relatively high construct validity, which is a necessary condition to be a good psychological testing instrument. The GPS scale has favorable psychomet-

ric properties (Klingsieck & Fries 2018, 3-6; Lodha, Sharma, Dsouza, Marathe, Dsouza, Rawal, Pandya & De Sousa 2019, 80.) The “Perceived Stress Questionnaire” (PSQ) emphasizes cognitive perceptions more than emotional states or specific life events and has high reliability, internal consistency, and high construct validity (Levenstein, Prantera, Varvo, Scribano, Berto, Luzi & Andreoli 1992, 31).

3.3 The Innovation: Vibe Tracker (Sensscale)

The process of innovation development consists of several individual work steps. The following part consists of a preliminary outline of the innovation development, the Unique Selling Points of the innovation and the Market Research Study, which was performed in March 2022.

Innovation development process

Initially, literature research had to be conducted on emotional intelligence, stress, working conditions and welfare technology. Data protection was an important issue, because user data must be treated with discretion, and data protection is strict when it comes to health data. In the EU, the protection of individuals regarding the processing of personal data is drawn up in the Directive 95/46/EC (1995). Therefore, the innovation must use two different databases and a tablet that every employee in the company uses, to ensure the anonymity of the employees (see Image 1). This has to been seen as basis-architecture for the implementation of the “Vibe Tracker”. Moreover, a consent forms has to be given, that each user must sign.

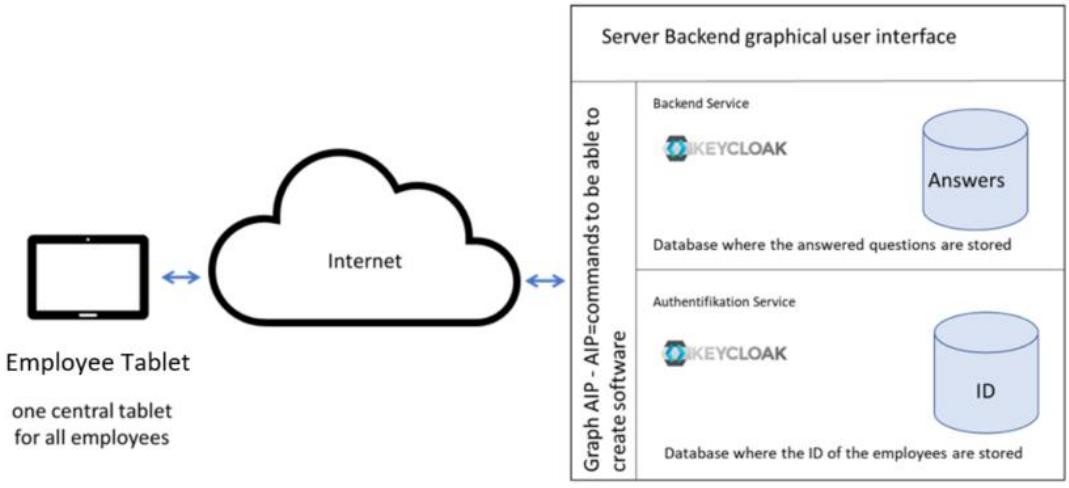

Image 1. Data protection

In addition, a short and long questionnaire were created. The short questionnaire, containing five questions, is based on already existing and scientifically-tested questionnaires, which will be explained in more detail in point 3.2 (USP of the innovation). The short questionnaire is implemented in the "Vibe Tracker" and should be used as often as possible by the employee (see Image 2).

Image 2. Short questionnaire

The long questionnaire, which consists of fifteen questions, is more precise and meaningful. It should be filled in once a month, for example, depending on the capacities in the company. It should complement the short questionnaire as an extended possibility to express one's feelings and well-being. In addition, an infographic has been added with essential and informative content, which should help the employees on a day-to-day basis. In this part, we also integrated short and simple exercises that can be done while standing in front of the tablet but can improve physical and mental health. This was followed by the elaboration of the innovation through a logo and a prototype.

Unique Selling Point (USP) of the Innovation

An innovation is a new or improved product that differs from previous products and has been introduced to market (Official Statistics of Finland n.d.). The innovation must have some Unique Selling Proposition (USPs) by which its uniqueness can be defined. The USP corresponds to the competitive advantage that users claim and is the center of its sales arguments or advertising campaigns (Franchise Portal 2022). The "Vibe Tracker" is distinct from existing technologies and applications, and its USPs are that it is based on a tested and accepted questionnaire, it is integrated in a tablet that every employee can quickly use, it includes some quick exercises and tips for health and well-being and that privacy is ensured by two databases.

The Israeli American sociologist and professor Aaron Antonovsky designed the “Sense of Coherence scale” in the 1970s. After he published his first research, many other studies and scales followed within this subject area: e.g., the “Defense Style Questionnaire-10 scale” for recording depression, also called the “Wittchen scale”, the “General Procrastination Questionnaire” (GPS) or the “Satisfaction with Life Scale” (SWLS) and many others (Rüesch, Volken, Bänziger & Gügler 2011, 3-9.) The questions of the questionnaire used for the application are based on these scales and questionnaires, as they are scientifically sound and proven to be able to determine people's mental health (Nebel, Wolf & Richter 2010, 265-269). Therefore, there is no difference between the questions used for the questionnaire in the application and those that are scientifically accepted. In the “Vibe Tracker”, for example, the first question “I am satisfied with my work” is from SWLS, the three following questions are from the GPS, and the last question is from the PSQ Questionnaire.

The “Vibe Tracker” is practical to integrate into everyday life, thanks to a tablet that could be used by every employee. Answering the five questions would take a maximum of two minutes. In addition, you can read through some health information or do some standing exercises. The integrated exercises are easy and familiar, there are several topics available, for example neck stretching or a breathing exercise.

The “Vibe Tracker” is implemented in the form of a tablet, so privacy is secured. To ensure privacy, everyone is required to sign a consent form, for the purpose of data protection. After that, everyone in the company uses the same tablet, so no tracking can occur. In addition, two different databases are used to store the data. One database contains all the personal information of the company, such as name, age, or date of birth. In the second database, the data of the questionnaires from the “Vibe Tracker” is stored, there assigned to an ID number, but no name. This enables complete encryption of the data and gives the employee a certain level of security and trust.

There is no such innovation in Germany or Finland which allows employees to indicate their feelings and mood every day and at any time. The fact that the questions contained in the “Vibe Tracker” are taken from evidence-based sources means that the significance can be strengthened and lead to valid evaluations.

Market Research Study

Marketing is a very broad concept which at least should answer these questions: what is the benefit for the customer (compared to what is offered by competitors) and what benefit does it bring to the company? (McKinsey & Company 2000, 67). During the innovation of the “Vibe Tracker”, a market research study was conducted. The market study was realized to get an insight into the market development.

Knowledge of a suitable market was determined using qualitative and quantitative questions (IAC Partners n.d.). In advance, the participants also gave their consent for the use of the data. The study was conducted in Germany and Finland. Both countries should be compared, for example, regarding the different development of the health care systems. Furthermore, an overview of the market development was given and possibilities of implementation in Germany as well as in Finland were analyzed. The participants were chosen from the health care sector which the innovation targets.

Three voluntary participants were found in both countries, and each carried out the market study. The content of the “Vibe Tracker” was described for the participants and then they were asked to complete the questionnaire, which was created in December 2021. The participants from Germany and Finland were all women. The average age of the participants in Germany is 42 years (range: 29 - 55 years). The job tenure is on average 18.6 years (range: 8 - 30 years), which represents a rather large spread. These values are not strongly meaningful because they are prone to outliers, which are present in this case. This is also the case with the values from Finland, where the average age is 39 years (range: 27 - 56 years). The average job tenure is 11.3 years (range: 2 - 30 years).

The occupations of the participants differ between the two countries. In Germany, mainly therapists (two occupational therapists and one physiotherapist) participated in the market study. In Finland, they were nurses with different academic degrees. A small difference of the stress level at work in both countries can be noticed. In Germany, the participants reported being stressed “sometimes”, which is more often than in Finland, where stress is not that present but rather “rarely” to “sometimes”. However, the causes mentioned are identical, namely limited staff or too many tasks in too short a time frame and too many patients.

The ”Vibe Tracker” was evaluated as a useful tool for the recognition of stress levels, for the use as a “daily magnifying glass” and as "an easy way to gauge the mood of the team”. Promotion of

health and well-being in the workplace, as well as statistical analysis of feelings are anticipated benefits of the innovation. In addition to these aspects, the change from perceived stress to self-awareness is of particular importance

The Finnish participants all indicated that they would like to use an application such as the “Vibe Tracker” in their daily lives. According to one participant, it would make sense to first use the application in only a few departments, test it, and then later use it in all departments, after adjustments through feedback and experience. This opinion was supported and extended by the German participants, the employees must get the feeling that there is interest on the part of the employers in the mood at the workplace and consequences are drawn from the results. All participants are convinced that the anonymity and security of the data is guaranteed. The condition that a tablet is used is satisfactory for the employees. The anonymity is essential, because "especially in these professions (therapeutic), not everyone wants to publish their opinion".

A frequently emerging opinion in both countries, regarding the long-term influence/improvement of the employees' mood through the results of the “Vibe Tracker”, is that the employees are consistently involved from the beginning and the handling of the results/data is clearly defined. In addition, workers learn a better sense of health and well-being, through the additional information and exercises integrated in the “Vibe Tracker”. Self-awareness and recognition of feelings can boost mood and add value to the innovation.

In the last question, whether the tips for stress reduction would help the participants to cope with stress, only one participant was not sure, because according to her, the “Vibe Tracker” is a good way to remember, but everyone in a medical/therapeutic profession knows in principle what is good and healthy, but the implementation of it usually fails. “I doubt the app will change that”. The other participants are convinced that the tips can contribute to better stress management. Receiving support by sharing with like-minded people who have the same problems and thoughts can improve stress management, using the “Vibe Tracker”.

The market study provided a good opportunity to learn about the implementation and use of the “Vibe Tracker”. In general, the innovation was well received by the participants in Germany as well as in Finland and the answers were mostly clearly and simply defined. The answers of the younger and older participants were not clearly distinguishable, which underlines a certain transparency and acceptance towards digitalization in healthcare in both countries.

3.4 Conclusion

The purpose of the article was to describe how employees' well-being can be improved by recording their emotions with the innovation "Vibe Tracker". There is a great benefit and need for such digital tools in the healthcare sector in Germany, as well as in Finland, to make the professions more attractive and pleasant and to ensure a certain constancy. By recognizing the early symptoms of i.e. stress, the "Vibe Tracker" supports the performance and ability to work. For example, electronic surveys etc. could be used for assessing personnel's well-being and they could also be combined with the guidance for support actions (Laukkala et al. 2020.) The "Vibe Tracker" would be a beneficial tool for early symptom detection in employees.

Various applications have been developed to help the working population suffering from stress and depression, such as the "Anchored" application, which included various tasks and programs to support mental well-being. According to the study, the use of the application was seen to have positive effects, especially in stress relief (Collins, Harvey, Lavender, Glozier, Christensen & Deady 2020). In the innovation "Vibe Tracker", not only is the questionnaire implemented, but also additional ways to reduce stress. An information chart with useful and general information about health is provided and there is also a possibility actively exercise for relaxation and well-being. Many algorithms are so sophisticated they can accurately predict mental illness (Graham et al. 2019, 2-9). Self-awareness and emotional intelligence are important topics of the innovation, because the employee should also learn how to manage their emotions and stress.

There is an urgent need for psychological support interventions for healthcare professionals, which is shown by many studies (Ceri & Cicek 2021, 90; Mahgoub et al. 2021, 11; Britt et al. 2020, 144; Frenkel et al. 2022, 21). The "Vibe tracker" was specifically developed for healthcare professionals, and the nature of the work has been taken into account. Therefore, it is quick and easy to use with a mood scale. Melms, Schaefer, Jerrentrup and Mueller (2021, 755) examined satisfaction when completing tablet-based digital surveys compared to paper based questionnaires. Most of the participants prefer the digital questionnaires. The "Vibe tracker" application can be used on a tablet, which is centrally located, and the questionnaires are easy to answer.

The "Vibe tracker" was designed to promote job satisfaction and emotional intelligence in the healthcare sector. The application covers several topics at once, it gives the employee and the employer a possibility to promote well-being and to improve mental illness. The market research study showed that the innovation would be used and accepted. But it also points out that it would depend on how changes are made by the employer and that the intension and the goals should

be communicated at the beginning of the use of the “Vibe Tracker”. In conclusion, the “Vibe Tracker” helps healthcare professionals to feel better and respected.

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4 Moodivation – a fitness tracking solution for health care employees to increase well-being, motivation, and fitness during work and private life

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Abstract

Health management is an important part of company strategy and crucial for employee satisfaction. Through smartphones and apps, new technology enables self monitoring and supports individuals maintaining a healthy lifestyle. Self-monitoring technology is used in many workplaces, and well-being applications play an important role in promoting employee well-being. Managers can make a significant contribution to employee well-being by encouraging employees to use health-related mobile technologies and apps. Wearable biometric devices (WBMDs) can help prevent disease and improve health. By monitoring quantitative data on items like activity, sleep quality, and recovery, people become more aware of the impact of their lifestyles on their health. In addition, it is shown that fitness challenges which are digitally presented in a playful way can also increase motivation.

The aim of the article is to provide tools for promoting well-being at work. The purpose of this article is to describe how health management and digital health monitoring can contribute to job satisfaction. This article also presents an innovation aiming at developing and supporting the health and well-being of the individual. Students develop innovation during their studies in the "Smart Solutions" program, which is part of the master's program "Digital Healthcare Management". The name of the innovation is Moodivation. It is a combination of the word's 'mood' and 'motivation', as the idea of the innovation is to improve well-being, motivation and monitor employee satisfaction. The innovation uses a personal health tracking solution combined with a tracking sensor and a smartphone personal data view in the work environment to improve employee motivation and well-being. The digital Moodivation app was developed first with mockups and finally with a small prototype. Expert interviews were conducted with staff working in nursing

homes and the results of their interviews about the Moodivation prototype are presented in the article.

Keywords: healthcare professionals, well-being at work, application, motivation, smart solution, innovation, fitness tracking

4.1 Introduction

People are increasingly interested in self-measurement and the physiological data it produces, which makes it possible to use the data to support their own health and well-being. Constantly evolving wellbeing and mobile technology solutions provide an opportunity to maintain and promote health behavior and thus the health and well-being of individuals. The ease of use and the suitability for the field of wellbeing applications to everyday life can be seen as a prerequisite for supporting individual self-control and enabling positive well-being effects. (Kaipainen 2014, 78.)

Promoting well-being at work is a matter for both the individual and the work community, as the employee's job satisfaction and functional relationships have a positive effect on the satisfaction and productivity of the entire work community. (Fassoulis & Alexopoulos 2015). Well-being at work consists of many factors in employees' everyday lives – both at work and in their free time. Its development is long-term and comprehensive work. (Manka 2011, 76.) Exercise is known to have positive effects not only on general well-being, but especially on obesity, diabetes, musculoskeletal disorders, anxiety and depression, and the prevention of these (Liikunta 2016).

The article presents a mobile application whose goal is to support the health and well-being of the individual, which increases well-being at work. The digital application is designed specifically for nursing staff and is intended for use both at work and during leisure time. The app tracks and gives data about the exercises.

The idea of self-monitoring is to increase the individual's awareness of their own well-being and the effects of the choices they make. With the help of the data collected, it is possible for an individual to monitor, for example, accumulated physical activity, which can increase the individual's motivation, and guide in making choices that support health and well-being. (Halttu & Oinas-Kukkonen 2017, 384.)

4.2 Theoretical foundations

Well-being at work

Well-being at work must be viewed as a whole and include management, competence development, good interaction and the employee's mental, physical and social health. (Manka 2011, 34–

35). Well-being at work improves job satisfaction, work motivation and the work atmosphere (Otala & Ahonen 2005, 69–70).

In the same work community, different employees can experience their own well-being at work in a very different way, as the interpretation is greatly influenced by the employee's psychological capital, the possibilities of influencing work, work community, health and even physical condition (Manka 2011, 76). Not only the workplace, but also life outside the workplace, which includes social relationships, lifestyles, health problems and attitudes, affects how they feel in the workplace (Virolainen 2012, 12).

Corporate Health Management

Mental and physical health of employees is a critical factor for companies. Musculoskeletal diseases and connective tissue (24.3 %) accounted for the largest proportion of diseases that can arise during work, as the SuGA Report of 2008 indicates (Weyer 2016, 297-313). This also has a negative influence on the mental health of employees and thus on their well-being at work and in their private lives.

That is why in working environments, health promotion activities have always been important in the past, but are increasingly seen as significant in view of economic crises. The maturity level of operational health management differs significantly between organizations. The larger the organization, the more frequently holistic health management is implemented. Since the 2017, the percentage of organizations offering sleep and rest measures has increased. It is noticeable, that studies show more than half of the companies already use digital solutions to implement health management. This includes, e. g., online coaching, health and lifestyle apps. Less commonly used are portable sensors that record physical activities or sleep patterns. Only in about 14% of organizations, is digital health promotion already implemented and reality, another 14% are currently planning to implement more offerings for their employees. Never the less, most employers are aware of the importance of company health management for their company. (Hübers, Baas & Schmitt 2020.)

Other studies show that corporate health management and its implementation in a company are decisive factors for success (Bechmann, Jäckle, Lück & Herdegen 2011). A report conducted by a German health insurance company proves that employees that feel valued by their employer on average have 2.7 fewer days of absence than other employees. In addition, with modern corpo-

rate health management, companies can increase employees' sense of meaning through authentic appreciation. It stands out that employees largely see the company as responsible for the health of its employees. (BGM Studien zur Wirksamkeit… 2021.) Concluding, one can say that health management is an important part of company strategy and important for employee satisfaction.

To ensure employee health, companies now have offers for fitness studios, back schools and/or the "active break", running groups or company sports. At the University of Augsburg, the "active break" has already been introduced for employees. The participants stated that their mental (39 %) and physical (29 %) condition improved. All these offers usually require a special affinity to sport and health, high personal motivation and sufficient time resources of the employees. (Weyer 2016, 297-313.) Employees at Augsburg University, for example, reported having no time (30 %) for "active breaks" (Göring & Möllenbeck 2015).

Tracking technologies in daily life

In the sector of sports, wearable technologies open a new era in athletes' training. For performance monitoring and evaluation and for fitness assessments, wearable technologies are very helpful. With sensor systems, e. g. biomarkers, they can collect, process, and transmit relevant data and evaluate the evolution of the athletes and therefore potentiate their performances. The results of the study showed that wearable technologies are not only used for fitness tracking but also for monitoring the athlete's internal and external workloads, employing physiological status and activity recognition. (Passos 2021.)

Tracking technologies for daily life purposes and personal health management are getting more popular all over the world. In people's daily lives, self-tracking technologies are widely used for health care in recent years. Feng, Mäntymäki, Dhir and Salmela (2021) identified the state of the art of self-tracking and quantified self in terms of health and well-being. For the end-user, motivation/goal setting, usage/effect of self-tracking, (continuance intention/long-term usage, management of personal data, rejection/discontinuance, and user characteristics) were the important themes. For people with illness, usage experience, management of patient-generated data and (dis-)advantages in the clinical context were important. The healthcare professional and caregiver defined collaboration among patients/health care professionals and changes in the roles of patient and professionals as very important themes.

To prevent disease and improve health, wearable biometric devices (WBMD) can help. By tracking quantitative data regarding, e. g., activity, sleep quality and recovery, people become more aware of the impact that their lifestyles have on their health. With the help of a biometric ring through a smartphone app, users have a significant improvement in sleep, daily step count, time jogging, VO2max, body fat percentage and heart rate variability. In conclusion, using WBMD in combination with personal training, encouragement, and feedback receives a better chance than using WBMD alone. (Browne, Boland, Baum, Ikemiya, Harris, Phillips, Neufeld, Gomez, Goldman & Dolezal 2021.)

Users who were confident with health technologies stated satisfaction and a sense of autonomy. Nevertheless there were also problems with personal information and data. The results suggest that people are highly interested in personal health technologies because it motivates. (Chamorro-Koc, Peake, Meek & Manimont 2021.)

Gamification in fitness tracking solutions

In addition, it has been shown that fitness challenges that are digitally presented in a playful way can also increase motivation. When designing such an application, it must also be considered that playful approaches such as fitness tracking gamification can give users a sense of personal responsibility. (Speicher 2021.)

Gamification is already being used in some mHealth applications to improve user experience and to leverage the features of video games that evoke fun in users and encourage them to keep playing. Additionally, using points and leveling systems and assigning users to icons or titles is important for user engagement. (Miller, Cafazzo & Seto 2016.)

4.3 Methods and Approach

The innovation designed by our team includes an app connected with a body sensor belt and management dashboard) with the aim of helping employees and employers in the healthcare sector to improve their well-being and motivation at work and as well in private life. It was designed by a multidisciplinary and international group of students. The basic idea for the innovation in the "Smart Solution" project came from the cooperating partner university in Finland. The innovation should be related to ‘Well-being‘ at work.

Sport and taking care of oneself are important components for well-being at work. An electronic platform should be developed, which can record sports activities completed during the day/week/month. The platform shall be accessible to workers at the workplace. In addition, the employees can compete against their work colleagues in games and challenges.

To find a gap in the market and better define it, a literature search, market analysis and survey was conducted. The research focused on fitness/exercise trackers as well as apps developed specifically for medical personnel. After that, the project idea was developed. This included among other things a process model, IT-Concept, Data Processing and Business Model Canvas.

The project team had weekly online meetings to distribute the subtasks and to compile the results that have been worked out or to inform themselves about the status of innovation development. A more intensive exchange took place during the International Week in week seven, which was held online. Here, the final steps were completed before the finished innovation Moodivation was presented at the end of the week.

4.4 Main Part

Introduction of the innovation

The innovation bears the name Moodivation. It is made up of the word's 'mood' and 'motivation', because the innovation's aim is to promote well-being, motivation and track employee satisfaction. Additionally, Moodivation solves the problem that employers are not aware of the mental and physical state of employees.

The innovation should be used during work as well as daily life. The digital application is specifically designed for medical staff (nurses, therapists, cleaning staff, office staff) who work, for example, in a clinic or rehabilitation center, both outpatient and inpatient. Moodivation tracks activities at work (e.g., moving a patient, going to the coffee kitchen, cycling to work etc.), shows how many calories the user burns in the activity. It summarizes all activities for each team in points and levels, whereupon teams can compete against each other. Every user has a digital character in the game in a digital hospital environment. In private, Moodivation tracks and gives hints on the exercises: relaxation exercises, jogging, walking, stretching and back training. During these activities, it can additionally track the user´s blood oxygen level. The innovation works with a sensor belt that can be worn on the body to track the movements or the activities. The sensor

relates to a smartphone or a tablet, on which the user can see all its data. The mentioned design of the App can be seen in Image 1.

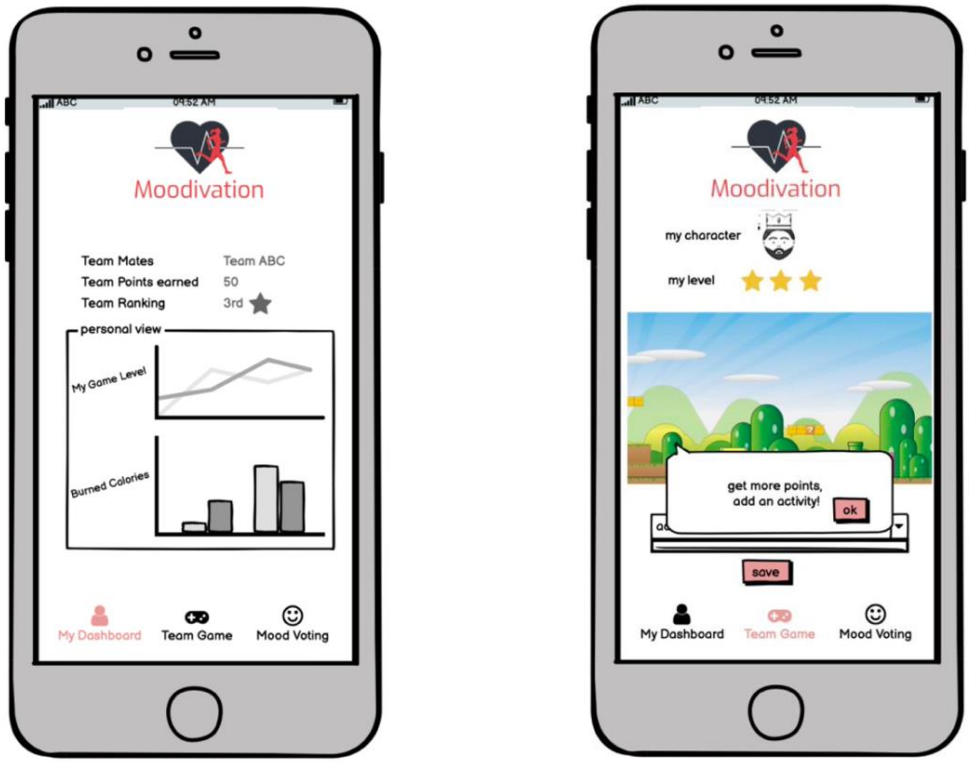

Image 1. Moodivation Mockups

Through feedback discussions, the development team decided to add a management dashboard in addition to the app for employees. It consists of the ‘Activities’, ‘Mindfulness’ and ‘Satisfaction overall’ dashboards. In the ‘Activities’ dashboard, the user has the option to select the age and job of employees related to certain activities. The overviews of the collected data are presented by means of descriptive graphics. In the dashboard "Mindfulness", users collect an overview of the mood of their employees, if desired also divided into "Work Mood" and "Private Mood". In addition, activities that have been carried out for the specified ‘Mood’ are shown. In the last step, the management department in a clinic, for example, can send suggestions for more satisfaction to the employees via push notification to the smartphone/smartwatch. Here, Moodivation provides activities for selection and searches for possible cooperation partners (for example, fitness studios, etc.). For Moodivation to bring maximum success to each company, the application is individually developed/tailored for the customer.

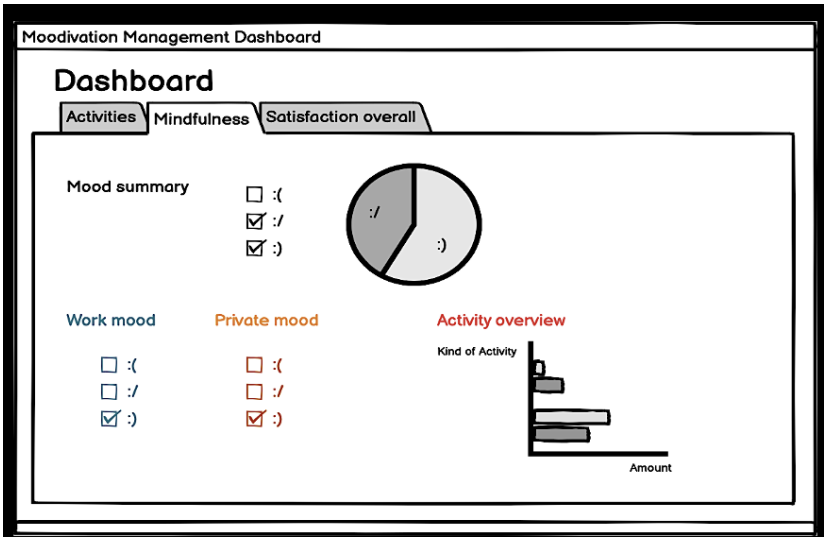

Image 2. Moodivation Management Dashboard Mockup

These dashboards can be personalized, so the management department can decide what data they need. These items of data are anonymized and cannot refer to a single employee. A possible further expansion of the dashboard functionality and design would have to be tested and evaluated in further research.

Usability and perception

To answer the research question and to test whether Moodivation fills the development gap, a qualitative study was conducted using expert interviews. For this purpose, five experts from the healthcare service sector in Finland were interviewed. All five experts were working in the same healthcare company and were in the age range of 25-35. One of the five experts was female und the rest were male. Two of five experts were physiotherapists and sports masseurs. Another two of the last three experts were practical nurses. One of them had ten years of work experience in the geriatric and psychological sectors. The last of the five experts was a manager with five years of work experience.

First, the prototype was presented to the subjects via video-click-dummy. The questionnaire, which was created in March 2022, contained four open and closed questions. The interviews were conducted via online meeting and subsequently transcribed and thematically analyzed.

Data Protection and IT-concept

As soon as data is collected and analyzed, the data protection law must be dealt with. For this purpose, the General Data Protection Regulation (GDPR) was consulted, since Moodivation has the goal of being used throughout Europe (Proton Technologies AG 2022). To protect personal data accordingly, the project team has developed the following concept. On the user's smartphone (mobile application), the data from the sensors (sensor belt) is stored asymmetrically encrypted. The mood summary (measurement of emotional state) is also stored there locally.

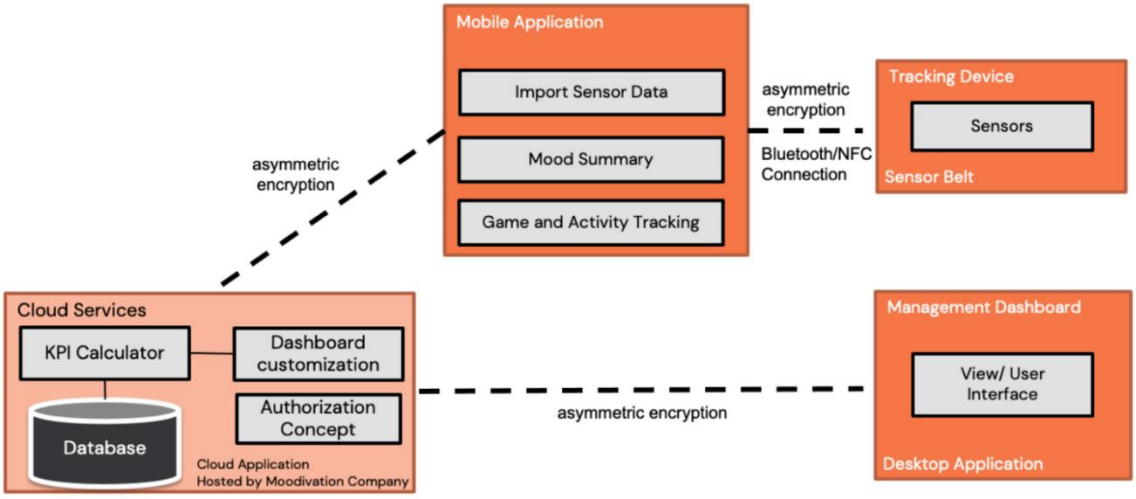

Image 3. IT-Architecture Concept

The overall IT architecture can be seen in Image 3. Data from the mobile device is exclusively sent to Moodivation's cloud services, but not directly to the management dashboard. The data is also sent asymmetrically encrypted. The belt's sensors measure the user's movement and calorie consumption and send the data asymmetrically encrypted to the mobile end device (= smartphone) via a Bluetooth or NFC connection. The management department can customize the dashboard by choosing between different metrics/KPIs and analytics. It is not possible to see individual employee data, solely the data from Moodivation's cloud KPI calculator can be accessed. Cloud services should be hosted and maintained by Moodivation itself.

Why have we chosen this solution?

The innovation was developed in this manner because it is the most practical for medical staff. Medical staff often has the problem that conventional fitness trackers such as wristwatches or smartphones do not meet the prescribed hygiene standards. Therefore, a belt was developed

that contains a sensor that is wearable under the working clothes without interfering with the work. It tracks all activities if it is worn. As soon as the healthcare professional takes a break and can access a tablet, computer or smartphone, they can see their collected data quickly and easily at a glance.

For further research purposes, a research question was defined to determine whether the selected innovation is beneficial for medical staff and is adopted by staff. Since the innovation has not yet been developed or tested in real life, a survey was conducted to test its practicality and to verify the objective formulated in the research question: can the fitness app Moodivation – including its sensor belt – help people who are working in the health care sector (nurses, therapists, managers etc.) increase motivation, fitness and well-being during work and in their private lives?

4.5 Discussion

The digital app Moodivation was first developed using mockups and finally through a small prototype. The video of the prototype was used for expert interviews. “Can innovation work in this way?” was discussed with experts by means of a questionnaire. Five experts that work in a nursing home were interviewed.

Four out of five experts would use Moodivation during their daily life and work. One of these is convinced of of the benefits of the digital recording of work. One expert would not use Moodivation during his daily work life. One expert is of the opinion that Moodivation would be only slightly accepted by employees, because nowadays there is an app or tracking device for every private and professional activity.

According to the experts, Moodivation manages to increase the motivation of the employees as they can compete with other teams. Moodivation has a good user experience and is helpful in tracking well-being and daily activities. When asked which features in the app particularly contribute to the desired goal, team building and competing with other teams were mentioned. Explicitly, the gamification with different levels was found to be good, as this particularly contributes to motivation. The purpose of gamification is to make things more motivating and comfortable. Game-like thinking utilizes all available information to create an addictive and motivating out-

come. (Werbach & Hunter 2012.) One expert did not find this feature useful. He rather recommends a feature in which the user can compete against himself and challenge himself. The uncomplicated registration process was also rated positively.

All experts agreed that Moodivation could still grow with more features. For example, one expert stated that he was missing the registration option ‘nursing or physiotherapy manager’. The last question, ‘Do you think apps like this can help to motivate employees and increase well-being at work?’, was answered with ‘yes’ by all experts. The purpose of self-monitoring is to increase awareness of one's own well-being and the effects of the choices one makes. With the help of the data collected, it is possible to monitor, for example, accumulated exercise, which can increase motivation, and guide in making choices that support health and well-being. (Halttu & Oinas-Kukkonen 2017, 384.) However, one expert was not sure whether Moodivation will be used permanently during daily work, as no smartphones are allowed in his institution and therefore the viewing of data must be done on another digital tool at work. One of the five experts summarized his assessment as follows: ‘It's good to see the difference between work and free time and how it affects your mood and wellbeing.

It is debatable whether too few experts were interviewed in the qualitative study. This renders it difficult to make a representative statement in relation to the population. Since only a video of the prototype was developed for Moodivation and not yet a finished application, the experts could only answer the interview questions based on the video. However, it must be considered that the interviews were conducted based on the video and that no finished prototype was available. Therefore, the answers could be different for a clickable prototype.

4.6 Conclusion and Prospects

Experts rate Moodivation as very motivating and beneficial in terms of well-being. The purpose of mobile applications for well-being is to maintain or improve a healthy lifestyle, quality of life and well-being. Being motivated has a positive effect on a person's well-being, only a motivated person can be happy at work. (Sinokki 2016, 262). Our innovation can therefore help people who are working in the health care sector (nurses, therapists, managers etc.) to increase their motivation, fitness and well-being during work and private life. These results ensure the purpose of the innovation, which is to provide an application designed for medical personnel, for whom the fitness trackers already implemented on the market are not designed. The application stands out

by accompanying, supporting and motivating users in their daily lives and not interfering or demanding more effort. For physically demanding activities, such as nursing, the app shows the user how much he or she has already physically done during work and can make suggestions for compensatory mental and physical activities.

The design includes gamification aspects. The utilization of gamification in activity tracking and fitness is motivating and engaging (Zhao, Etemad & Arya 2016). Managers can make a significant impact on employee well-being by encouraging employees to use health-related mobile technologies and apps. Wellbeing apps and their monitoring play an important role in promoting employee wellbeing. (Witters & Agrawal 2014.) This effect is applied by our innovation.

Studies show, the higher the degree of implementation of a health management system, the higher its effectiveness. Positive effects are the improvement of employer attractiveness, higher employee motivation and increased employee performance (BGM Case Study 2011). Moodivation can thus be well incorporated into corporate health management. By using Moodivation, employees are no longer bound to fixed "well-being events" offered by the company health management and, for example, "active breaks" can be integrated into the daily work routine. Thus, activities can be linked to the daily work routine and no specific time or period is required for them. A ubiquity is created.

There are also important lessons to be learned about tracking technologies. No positive change in the user's behavior can be reached if the user rejects the tracker's introductions. It can have a positive effect on user's health if they wear activity trackers to measure their movements and are willing to accept the advice the application gives. Our innovation visualizes the course of activities and mood; this has been proven to promote personal ambition (Becker & Stammer 2017).

During the project, it became clear that an interdisciplinary team was needed to develop new ideas. Professional and technical expertise were a good combination for our team. Further surveys could be conducted in the future, and the prototype could be improved incrementally so that the innovation becomes a marketable product. The team also thought of an addition that would allow a management team to measure the performance and satisfaction of the teams based on selected KPIs. Due to the available time, this feature was not explored further, only low-fidelity mockups were developed. This could serve as a basis for further work and research.

The management department also has many advantages through the digital application. It is possible to get dashboard access via the additional package, where data can be viewed, the employer

is informed about the well-being of employees and, if necessary, can react and take an active part, managing employees well-beeing by using Moodivation.

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5 "Smart Shoes" for well-being service development and management – scoping review in the context of Ambient Assisted Living

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Abstract

Memory diseases are an increasing problem in the world. The number of people with memory disease is estimated to triple by 2050. People with dementia have the right to a safe and dignified life. That is why the world is looking for ways to enable people to live a dignified and prosperous everyday life despite dementia.

The aim of this article is to develop a smart solution that helps a person with a memory disease to have a self-empowerment life. Technology allows us to enable routines to be maintained despite memory disease. The innovation smart shoes is a future-proof innovation, which provides assistance to the patients themselves, but also to relatives, physicians and nurses in dealing with diseases like dementia. The combination of tracking system and geo fence, therapeutic support tool and data collection for evidence-based medicine render the smart shoes a sustainable and innovative product, which has high potential in dealing with diverse diseases like dementia. Particularly in the area of Ambient Assisted Living, smart shoes can develop its potential, as long as it takes into account and counters the existing challenges. The smart shoes innovation was developed as part of a course called Smart Solutions for Wellbeing Services Development and Management.

Keywords: Memory Disorder, Memory Disease, Dementia, Smart Devices, Movement Analysis, Tracking, Ambient Assisted Living

5.1 Introduction

The World Alzheimer Report 2021 predicts that over 55 million people live with dementia worldwide. By 2030, there will be approximately 78 million people with dementia. (Gauthier 2021, 19.) The number of people with memory disorder in Finland is estimated to be over 190,000. It is assumed that about 14,500 people become ill in Finland each year (Memory diseases 2022). Getting lost is one of the early symptoms of Alzheimer's disease. Persons with a memory disorder in mild dementia can also experience disorientation and account for 43.7% (Agrawal, Gowda, Achary, Gowda & Harbishettar 2021, 54.): dementia sufferers walk away from their homes and are found lost in an unfamiliar place. Getting lost not only puts at risk the person with dementia, but also stresses caregivers and puts a strain on the authorities. (Wang, Kuo, Ma, Lee & Pai 2012, 781.) Memory disease affects short-term memory loss and can cause confusion, difficulty perceiving or misplacement of goods. In this case, it is important for people with memory disease to be able to live in a familiar environment, wear familiar clothes and live safely.

The monitoring of dementia patients enables objective recording of the patients' movement patterns. The characteristics collected during this process, which are irregular compared to normal movements, can provide indications of behavioral changes. Automatic data acquisition by means of intelligent assistance systems represents a future-proof innovation. (Lösel 2018, 11.)

Ambient Assistant Living (AAL) is intended to enable older people to live independently, safely and autonomously in familiar surroundings with the help of technology. AAL in familiar surroundings supports people to live at home for longer, with a cost-effective impact. (Andone, Spinu, Daia, Stoica, Onose, Anghel & Onose 2020, 445.) The concept also improves their quality of life (Sanchez-Comas, Synnes & Hallberg 2020, 2). Social and health professionals are motivated by the well-being of their clients, which has an incentive effect on the use of technology. Wellbeing technologies are expected to have a positive impact both on different services and on the work of social and healthcare professionals. (Kivekäs, Kekäläinen, Kaija-Kortelainen, Kinnunen, Kämäräinen, Aallosvirta & Saranto 2020, 237.)

The aim of this article is to develop a smart solution that enables a person with a memory disease to have a self-empowerment life. With the help of smart shoes, patients should be able to live a self-determined live for as long as possible, thus relieving the burden on nursing homes and the health care system.

The purpose of this article is to describe the functional requirements, necessary features and challenges of the smart shoes in the context of AAL and why the smart shoes offer an added value for people suffering from dementia, relatives and the health care system. In addition, the advantages of the all-in-one product in comparison to single-component products as well as the benefit of comprehensive, wide-ranging data analysis should be highlighted.

5.2 Background

The core idea of the Smart Shoes innovation was based on many years of working experience as a memory specialist. The innovation begins with the problem that people suffering from cognitive diseases such as dementia or Alzheimer's tend to disappear due to disorientation. This can lead to considerable stress and strain situations both for those affected and for their relatives and caregivers. Their considerations were aimed at locating the dementia patients with the help of an app and a tracker. Instead of existing necklaces, bracelets or watches that are equipped with a tracker, the innovation focused on shoes with an implemented tracker in the sole as a new innovation. The idea is substantiated with the fact that, based on specific working experience, shoes are less likely to be forgotten when planning a walk or a "need to run away" than the previously mentioned devices.

With the help of smart shoes, patients should be enabled to live self-determined lives for as long as possible, thus relieving the burden on nursing homes and the health care system. Furthermore, the article is intended to show that the system integration of various components enables enormous add-on value compared to individual applications, as the diversity of functions and components enables comprehensive data recording and analysis, thus providing an overall picture of the disease. In this way, the shoes can also contribute to the digitization of the healthcare system and enables data collection for evidence-based medicine.

5.3 Preliminary Study

In the first semester of the Master’s course, a prototype was developed in an interdisciplinary manner. Based on the above-mentioned problem, an initial unstructured literature search brought to light that there are already similar concepts in terms of content, such as tracking shoes (GPS-Schuhe sollen Alzheimer-Patienten bewachen 2011) and soles with integrated trackers

(Corp 2022). The challenge was not only to develop the core idea further, but to redefine it. After consulting an expert in the health sector, the project team decided on the strategic orientation of the innovation for therapeutic purposes. This was followed by the second systematic literature search in medical databases. After narrowing down the literature using a search strategy (see Table 1), 51 scientific studies were soundly identified.

Table 1. Search Strings Prototype

Database	Search string	Databased filter	Date of search and results
PubMed	Dementia* OR Alzheimer* AND Therapy AND Movement AND Tracking	Free Full Text 2000 to 2021	01.12.2021 N = 22
Livivo	Movement Dementia AND Therapy AND Tracking	Freier Zugang 2000 bis 2021	01.12.2021 N = 6
ProQuest	Tracking Dementia mHealth AND Movement Analysis	Volltext 2000 bis 2021 Englisch	01.12.2021 N = 23
Total included in search			**N = 51**

Studies and articles analyzing dementia patients based on gait and movement patterns are particularly prominent. According to Buckley, Alcock, Mcardle, Rehman, Del Din, Mazzà, Yarnall & Rochester (2019, 1), such analyses provide valuable information for understanding neurological diseases in which motor symptoms predominate and cause significant functional impairment. In addition, further findings included that physical activity leads to improvements in gait speed, functional mobility and balance in all stages of dementia (Blankevoort, Van Heuvelen, Boersma, Luning, De Jong & Scherder 2010, 393). The literature reviews and their findings created a lasting impact on the purpose of the innovation and steered it in a new direction. This allows three objectives and use cases to be formed, which at the same time represent the unique selling point (USP) of the innovation:

1) Tracking System

Using a GPS tracker implemented in the shoe, relatives or caregivers who look after the resident in a home can locate the person by means of an application (app). Thus, on the one hand, the patient can maintain sovereignty over a self-determined life in which he or she can decide independently of the caregivers and relatives when to go for a walk. The relatives or responsible caregivers can be relieved of worries and fears regarding disorientation and the disappearance of the person in care. They can set up a geofence function with a so-called "invisible fence". The fence primarily represents a protective function for the person affected. The size of the zone can be adjusted for the individual disease progress of the person. On the other hand, the person with

dementia has been encouraged to move, which, according to scientific findings from the literature, can lead to prevention and alleviation of the disease.

2) Therapeutic support tool

With the help of the data from the tracking system, conclusions can be drawn about the degree of disease maturity. The doctor, physiotherapist or other responsible health professionals can use a movement profile to analyze progress or changes to the current disease status. Improvements or deteriorations can thus be put in relation to drug therapy, for example. The innovation only generates data for the health professional. An evaluation and independent diagnosis-related creation of the movement profile is not planned for the prototype.

3) Data collection for evidence-based medicine

Currently, there is still insufficient meaningful scientific knowledge on the clinical pictures of dementia and Alzheimer's disease. The relevance of the research area is underlined by various funding opportunities such as the "Alzheimer Forschung Initiative" (Mit der AFI die Alzheimer-Krankheit heilen 2022) or the "Deutsche Alzheimer Gesellschaft e.V. Selbsthilfe Demenz" (Über uns 2022). With the help of innovation, health professionals are offered the opportunity to conduct independent research. On the basis of collected data, patterns can be recognized in order to create a data pool and to bundle scientific findings in the sense of evidence-based medicine.

After the research was done and the new use of smart shoes was manifested, the project team developed the concept further and identified three modular components: smart shoes, associated software or app for the caregivers and hardware in the form of a base station for the doctor.

To be able to develop a product that is precisely customized to the client, various analyses were performed regarding the target group. In particular, the aim was to find out which people are potential users of the product smart shoes, what characteristics these groups of people have, and which groups of people influence the innovation. This is the only way to ensure that the product becomes established on the market and creates the basis for the detailed design of the product.

For the conception of the shoes, in addition to further research, three interviews were conducted with experts from the health sector to understand the needs of the users. The results were considered in the concept and a sporty grey shoe that stabilizes the leg muscles, reduces the risk of falling and is easier to use due to Velcro fasteners was designed. A tracker with the following functions was integrated into the sole of the smart shoes:

- GPS interface for determining position and movement data (speed, step length and direction of movement)
- Memory card
- Bluetooth interface for data transmission of the base
- Induction surface for wireless battery charging

While designing the app, after evaluating the interviews, special attention was paid to a simple user interface, good usability in connection with the different functionalities (map view, tracking dashboard, news portal) and compliance with data protection. The affected persons do not need any technical skills to operate the innovation.

The base station consists of two elements, a sensory shoe mat and a tablet (Figure 1). On the mat, Color-contrasting shoeprints with a transmission icon indicate how to place the shoes correctly on the mat.

Figure 1. Smart Shoes and its devices

The correct positioning of the smart shoes is elementary for the inductive, wireless recharge of the battery of the embedded tracker. The shoe prints are made of rubber to prevent the smart shoes from slipping off the mat during the charge process and ensure an optimal grip of the smart shoes on the shoe mat. An LED indicator in the right corner of the mat shows the current charging status. The aspect of inductive charging is particularly noteworthy, because now the patient suffering from dementia does not have to remember to charge the battery actively. Putting on and

taking off shoes is a matter of course for most patients and is therefore less frequently forgotten. Beside the charging process of the shoes, the automatic data transmission is realized by Bluetooth. The transmission takes place as soon the smart shoes are within reach of the corresponding tablet. The data is graphically processed on the tablet and is available to the user in a very short time, so that doctors who want to have access to the movement data do not need their own compatible equipment. To ensure that the collected data is not misused, several security measures were taken, such as code registration or an encrypted point-to-point connection. The prototype was summarized in a project report at the end of the semester.

5.4 Materials and Methods

Scoping Review

The scientific methodology of the scoping review is used to investigate the topic of Ambient Assistant Living in the context of smart shoes. Scoping reviews are used when an initial orientation on the state of the research literature is to be obtained. They are prepared, for example, to establish preliminary working definitions or to conceptually delineate topics or topic areas. In addition, the method is suitable for bundling research results, identifying research gaps and making recommendations for future research work (Von Elm Schreiber & Haupt 2019, 1). In contrast to other types of reviews that address relatively precise questions (such as systematic reviews on the effectiveness of interventions based on well-defined outcomes), scoping reviews serve to map the key concepts of a research area or to delineate the substantive boundaries of a topic (Arksey & O'Malley 2005).

The objective is to make a transfer between the innovation of smart shoes and the field of application of AAL. With the help of the methodology, an overview of the current state of research in connection with AAL systems is to be provided. An analysis should show which competences, requirements and challenges are currently in demand and to what extent Smart Shoes can be used for this.

Literature selection and strategy

Two different scientific databases were consulted to identify suitable published literature. The search is limited to a period between 2000 and 2022. The last search took place on 13 May 2022. The search strings used for the databases are replicated in Table 2.

Table 2. Search Strings AAL

Database	Search String	Databased specific filter	Date of search and results
PubMed	Ambient assisted living Technology AND Usability	Free Full Text 2000 to 2022	17.05.2022 N = 23
Livivo	Ambient assisted living AND senior*	Freier Zugang 2000 bis 2022 Artikel	17.05.2022 N = 27
Total included in search			**N = 50**

The search resulted in 50 cumulative studies. In the next step, the identified studies were subjected to a selection process. For this purpose, the literature management program "Covidence" was used. The literature selection was based on the "Preferred Reporting Items for Systematic Reviews and Meta-Analyses" (PRISMA) scheme (Moher, Liberati, Tetzlaff & Altman 2009). The PRISMA scheme is illustrated in Figure 2.

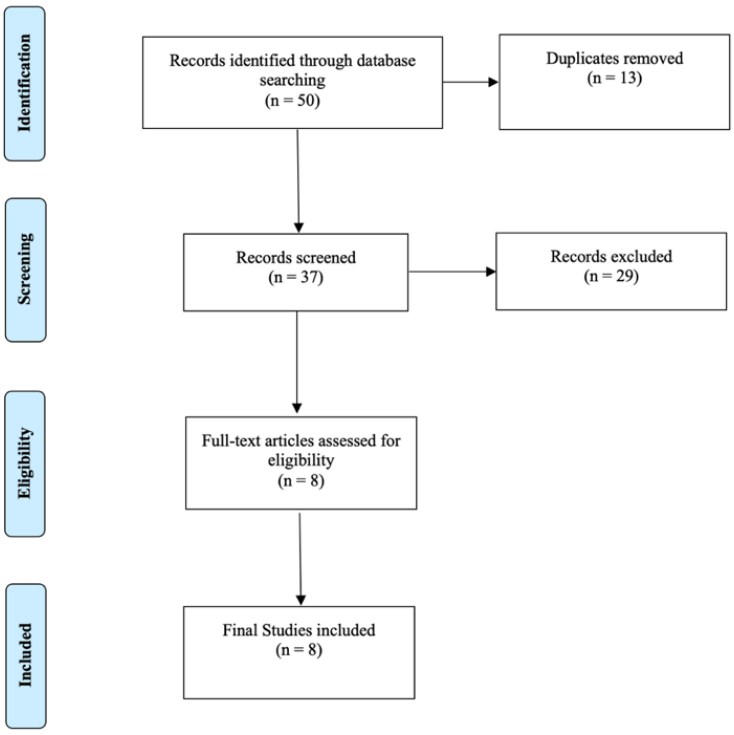

Figure 2. PRISMA flow diagram of the study

At the beginning, the search results from the databases were imported into Covidence. In the second step, "screening", the project team independently undertook a title and abstract review. These checked whether the studies fitted the topic. All studies with AAL applications that did not deal with the target group of seniors were excluded. In addition, no reference books were integrated, only studies and articles in English and German.

Out of 37 studies, 8 were finally included in the review and approved for data extraction. The data of the included studies were extracted according to selected variables in a data chart in Microsoft Excel and compared with the developed concept of Smart Shoes.

5.5 Results

Policy dimension

Based on the available literature, there is now a variety of AAL. The use and development of AAL technologies is increasing significantly (Memon, Wagner, Pedersen, Beevi & Hansen 2014, 4330). It can be deduced from this that AAL is gaining increasing recognition and acceptance from both consumers and industry. The reason for this is, for example, that AAL systems can contribute to relieving the burden of care (Gettel, Chen & Goldberg 2021) by adapting the technology to the individual care modalities (Palmdorf, Stark, Nadolny, Elias, Karlheim, Kreisel, Gruschka, Trompetter & Dockweiler 2021, 1-2).

In addition, AAL systems can be of great benefit especially for residents of rural areas (Leitner, Felfernig, Fercher & Hitz 2014, 13527). Saving human resources is therefore one of the key components of AAL systems. According to Vimarlund & Wass (2014, 147-148), the potential is not yet sufficiently promoted by policy. New suitable business models should be developed, as well as an increase in competition and the definition of measures to ensure data protection, security and liability should be regulated.

Technical dimension

On the technical side, there is still room for improvement (Leitner et al. 2014, 13527). Especially low battery life and insufficient accuracy of the data currently limit the use (Gettel et al. 2021). In addition, not all essential aspects of AAL systems are considered in the implementation. The lack

of interoperability with other systems is problematic. To avoid this, the perspectives of an interdisciplinary team (relatives, caregivers, IT specialists, etc.) should already be included in the development cycle of AAL systems (Memon et al. 2014, 4332). Furthermore, a study states that AAL systems can be based on Big Data in the future (Vimarlund & Wass 2014, 148). The use of data will thus not only serve self-monitoring purposes, but also the collection of data for prevention, diagnosis and treatment of diseases (Gettel et al., 2021).

According to Vimarlund & Wass (2014, 147), it is also recommended to realize AAL systems with corresponding backend algorithms. Caregivers thus collect data in the field, which the algorithm then processes, analyses, and provides as an application for detecting abnormal behavior. This solution can then be evaluated by the caregivers. However, the experience gained and the qualitative feedback can serve as inspiration for the development of Ambient Assisted Living Services (AAL) (Aloulou, Mokhtari, Tiberghien, Biswas, Phua, Kenneth & Yap 2013, 16).

User dimension

Users are particularly concerned about data protection and security (Gettel et al. 2021). There is a lack of transparency and education about data processing. Furthermore, more strong clinical evidence on imple-mented technologies (Al-Shaqi, Mourshed & Rezgui 2016, 17) and user experience studies (Memon et al. 2014, 4332) are needed to identify which data are really relevant for users (Palmdorf et al. 2021, 7) and which functionalities can be further improved. To keep AAL systems operational in daily use, end-users need con-siderable technical support and supervision by qualified IT staff. However, the purchase and maintenance of these systems is a major cost factor (Memon et al. 2014, 4332.) According to Gettel et al. (2021), AAL systems can nevertheless contribute to increasing the sense of safety and thus also to improving the quality of life of the person with dementia, as well as facilitating caregivers, relatives and others (Abrantes, Teles, De Sousa, Freitas, Vieira-Marques & Ferreira 2021, 2).

Table 3. Data extraction of scoping review results

Source	Type of study	Study object	Evaluation metrics	Research findings
Gettel, C. J., Chen, K. & Goldberg, E. M. 2021. Dementia Care, Fall Detection, and Ambient-Assisted Living Technologies Help Older Adults Age in Place: A Scoping Review. Journal of applied gerontology: the official journal of the Southern Gerontological Society, 40(12), 1893–1902.	Scoping Review (n=54)	Technologic advances in the domains of dementia care, falls, and home supports Especially AAL: - home monitoring systems (n=13) - walking applications (n=2) - care robots (n=1) - digital calendars (n=1)	Usability	- concerns about data protection and privacy - low battery life, insufficient accuracy - improvement of the sense of security - relieving the burden on caregivers - use of sensor data not for self-monitoring but also for prevention, diagnosis and treatment of diseases
Palmdorf, S., Stark, A. L., Nadolny, S., Elias, G., Karlheim, C., Kreisel, S. H., Gruschka, T., Trompetter, E. Dockweiler, C. 2021. Technology-Assisted Home Care for People With Dementia and Their Relatives: Scoping Review. JMIR Aging, 4(1), e25307.	Scoping Review (n=175)	Technology-assisted home care for people with dementia and their relatives - ambient assisted living (8/175)	Types of technologies	- technical solutions that fit individual care - research on the users' information's - higher acceptance - variety of supporting technologies - demonstrates the increased availability of assistive technologies and recognition of family members and people with dementia as consumers
Memon, M., Wagner, S. R., Pedersen, C. F., Beevi, F. H. & Hansen, F. O. 2014. Ambient assisted living healthcare frameworks, platforms, standards, and quality attributes. Sensors (Basel), 14(3), 4312–4341.	Scoping Review (n=113), Qualitative research (E-mails survey)	Research: 1. most important AAL concepts 2. current state of the technic 3. current use and real-life application of AAL systems and platforms	Interoperability, integration, user experience, standards, architectures, security, usability and design methods	- use of AAL systems is increasing - in some cases, not all essential aspects of AAL systems are taken into account (lack of interoperability properties). - end-users need considerable technical support and supervision by qualified IT staff - acquisition and maintenance is expensive - more user experience studies needed - important: involvement of caregivers, IT sector
Vimarlund, V. & Wass, S. 2014. Big data, smart homes and ambient assisted living. Yearb Med Inform, 9(1), 143-149.	Scoping review (n=110)	To discuss how current research in the area of smart homes and ambient assisted living will be influenced by the use of big data.	Big Data, Business Models	in the future it will be of importance to: - design smart home services based on big data - develop new business models - increase competition and identify policies to ensured privacy, security and liability
Al-Shaqi, R., Mourshed, M. & Rezgui, Y. 2016. Progress in ambient assisted systems for independent living by the elderly. Springerplus, 5, 624.	Review (n=133)	Critical review of the framework and sensor systems, assessment of technology	Evaluation	- most systems focus on activity monitoring - lack of evidence-based proof for technologies

Aloulou, H., Mokhtari, M., Tiberghien, T., Biswas, J., Phua, C., Kenneth Lin, J. H. & Yap, P. 2013. Deployment of assistive living technology in a nursing home environment: methods and lessons learned. BMC medical informatics and decision making, 13, 42.	Observation research (n=10)/ qualitative research	The aim of this paper is to present the approach we have adopted to develop and deploy a system for ambient assistive living in an operating nursing home, and evaluate its performance and usability in real conditions.	Evaluation, performance, usability in real conditions	- on-site data collection is important - integration of a function that analyses this data and provides valuable clinical knowledge - an analysis of the data collected during this deployment allowed us to demonstrate the ability of the proposed solution to detect abnormal behaviors and to evaluate the performance of the system with the help of caregivers.
Leitner, G., Felfernig, A., Fercher, A. J. & Hitz, M. 2014. Disseminating ambient assisted living in rural areas. Sensors (Basel), 14(8), 13496–13531.	Project research "Casa Vecchia-Project"	Investigating the feasibility of AAL in rural areas.	technology-related aspects; data processing, activity tracking; aspects related to interaction and socio-psychology.	- important result; it is not possible to research AAL thoroughly without going into the field - Still room for improvement at the technical level - AAL could be of great benefit specifically for rural residents, but the systems must meet certain requirements in order to fulfil the needs and be accepted by their users.
Abrantes, D., Teles, S., Tavares De Sousa, R., Freitas, A., Vieira-Marques, P. & Ferreira, A. 2021. A Multipurpose Platform for Ambient Assisted Living (ActiveAdvice): Usability Study. JMIR Aging, 4 (1), e18164, 2.	Usability study (n=32)	Aims to describe the usability and users' experiences within a novel platform, ActiveAdvice, aimed at offering advice and a holistic market overview of AAL products services.	Usability, User experience	- AAL can improve quality of life - tools may benefit not only older adults but also caregivers, business owners, and governmental employees

Table 3 describes the material selected for review. The authors of the article and the information in the article are summarized in the table as a basis for later interpretation. In addition, the table shows the type of study, the subject of the study, the evaluation indicators and the results of the study.

5.6 Discussion

The results of the scoping review have shown in particular that various stakeholders have to fulfill a key role in the context of AAL. Therefore, the importance of selected stakeholders in relation to AAL will be highlighted in the following discussion and transferred to the innovation shoes.

In the context of ambient assisted living, a categorization of the users into three groups (primary user, secondary user and teritary user) provides a useful setting for analyzing users needs. The primary users regarding the innovation smart shoes are the dementia patients who wear the shoes. Secondary users are relatives and caregivers, who also make use of the innovation. Tertiary users are, e.g., insurance companies or institutions that pay or organize the AAL System. (Nedopil, Schauber & Glende 2013a.) There are many different methods of user integration, like persona, Walt Disney Method or Cognitive Walk-though (Nedopil, Schauber & Glende 2013b). As part of the innovation smart shoes a persona description was carried out to address the target group precisely.

As stated in the results, the quality of life of the primary user should be increased with the help of AAL systems (Gettel et al. 2021), as well as secondary users such as caregivers, relatives and others should be supported (Abrantes et al. 2021, 2). The target group for AAL systems is often elderly people who do not see any point in integrating the products and with older age, the use of innovative technologies by older people is more often associated with difficulties. Therefore, the acceptance for the innovative solutions must be ensured to a greater extend. This can be achieved in particular by supporting relatives, but also by doctors and nursing staff. Dementia is a special case in this context; since both patients and their relatives are affected by the disease, all stakeholder groups must be integrated. (Nedopil et al. 2013a, 15, 22.) Therefore, within the scope of the innovation, we have dealt in particular with the stakeholder relatives and caregivers in order to be able to promote the product in the best possible way.

As discovered, AAL systems can contribute to relieving the burden of care (Gettel et al. 2021) by adapting the technology to the individual care modalities (Palmdorf et al. 2021, 6). In case of the innovation smart shoes the physician can be assisted in the diagnosis of the current dementia status with the help of the movement profile. Nurses, on the other hand, can be relieved by the use of the shoes in nursing homes, since patients can move freely by wearing the shoes without the risk of getting lost. Therefore, it is also very important to take the wishes of this stakeholder

group into account and to integrate them into the development process (Nedopil et al. 2013a, 11-12). In the context of the innovation smart shoes, this aspect was realized by means of expert interviews. However, caregivers do not only benefit from the innovation, but also represent a key player in the the commercialization of the product. Thus, for the promotion of the smart shoes, cooperations with dementia clinics, rehab clinics and nursing homes are to be established in order to address the target group. The smart shoes must be provided to the above-mentioned areas, so that the shoes can be tested by patients for private use on the one hand. On the other hand, additional equipment is to be lent to the relevant facilities so that they can use it in their own clinical areas. As a basis for this, the service providers must be trained. This is to be realized in particular by means of lectures and free training.

According to the article Technology-Assisted Home Care for People With Dementia and Their Relatives: Scoping Review ALL systems are used second most by relatives of dementia patients (38.9%), just after the patients themselves (44.0%) (Palmdorf et al. 2021, 4). Accordingly, the relatives of dementia patients can also benefit from the innovation. However, they also have important responsibilities in the context of the innovation. On the one hand, relatives receive information about the patient's position and can track the patient's whereabouts. They consequently have a duty of care. On the other hand, the relatives also play an important role in encouraging the patient to use the product. As explained above, the use of innovative products by the elderly is often associated with technical difficulties. Therefore, it is the task of the relatives to support the patient in using the shoes, e.g., concerning loading process or installing. However, the main task of this stakeholder group is to convince the patient about the advantages of the shoes, to gain their trust and to explain unclear aspects of the product.

In addition to the exceptional importance of the stakeholders presented, the topic of interoperability plays a significant role in the field of AAL (Memon et al. 2014, 4318, 4332). The interoperability of systems is often noted as a challenge for consistent data recording. In the context of the innovation shoes this topic was already taken up in the development of the product and the system integration of various components was implemented. This represents an enormous added value compared to silo systems, as it ensures homogeneous and comprehensive data recording and facilitates interoperability.

5.7 Conclusion

Living independently and self-determined in the own house as long as possible – that is the wish of almost all senior citizens. For people with memory disease, this is not possible without the help of their relatives or caregivers. A shortage of staff, overcrowded nursing homes and old people's homes and relatives who work full time also make it difficult to provide care. The starting point of the innovation smart shoes was to use an integrate shoe tracking system to locate the diseased and thus to anticipate or prevent a dangerous situation (such as walking). Due to various influencing factors during the development process and with the aid of literature research, analytics and interviews, a prototype of the smart shoes could be designed. The individual product became a smart all-in-one product that contains both the tracking function and functions as a therapeutic tool and offers potential for evidence-based data collection/analysis. Furthermore, the smart shoes can not only support the diagnosis in the field of dementia but also in the area of other diseases , e.g. Parkinson. The combination of tracking system, therapeutic support tool and data collection for evidence-based medicine render the smart shoes a sustainable and innovative product, which has high potential in dealing with diverse diseases such as dementia.

Furthermore, it is aimed at investigating the added value of smart shoes for people with dementia as well as for their relatives, caregivers, and the healthcare system. The evidence for this is taken from the results of the scoping review for AAL. Based on the literature review of AAL, important functional requirements as well as challenges can be identified and transferred to smart shoes. For example, the data analysis can determine how advanced the dementia disease is. Based on this, the care modalities can be adapted (Palmdorf et al. 2021, 6). In addition, control visits and the associated long journeys in rural areas can be reduced, as the relatives can locate the person with dementia with the app. Acceptance and recognition of AAL increases. (Memon et al. 2014, 4313, 4322). The perspective of the relatives is particularly relevant here, as they must approve the application as guardians. The literature indicates that there is still a lot of work to be done, especially with regard to data protection. (Gettel et al. 2021). For the use of smart shoes, evaluations of the user experience and customer care are therefore indispensable to support the technical components (Memon et al. 2014, 4332). The system integration of different components allows an enormous added value, as a comprehensive data collection and analysis is guaranteed and a comprehensive medical picture can be presented, thus contributing to the digitalization of the health care system and ease the data collection for evidence-based medicine.

On an individual level, smart shoes can preserve some of the quality of life of people with memory disease by improving care measures through data analysis and motivating them to move safely outside their four walls, thus positively influencing the course of the disease. On a collective level, smart shoes contributes to relieving resources as an AAL system by enabling people with disease to live at home longer and by drawing conclusions about the course of the disease through interoperable data collection.

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6 VR emergency Training app

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Abstract

The innovation of VR emergency training was developed as part of a course called Smart Solutions for Wellbeing Services Development and Management. The course was designed to create health care innovations. The innovation team, consisting of three Master of Digital Health Care students (Germany) and one Master of Health Care student (Finland), developed a specialized fire emergency training for operating theatre (OR) staff using VR-simulations and VR-glasses. The innovation was carried out through intensive literature work, methods from design thinking and qualitative research, with the implementation of qualitative interviews. The aim of this article is to develop digital solutions for the training of emergency and fire safety activities. The purpose of the article is to describe the evolution of the VR emergency simulator from an innovation to a prototype.

The results show that there is a deficit in traditional emergency training in hospitals. Further, the training method using VR simulation has many advantages compared to the traditional method. The results presented in the article can thus confirm the purpose of the innovation. Apart from developing better emergency skills through improved learning effects and knowledge retention of the OR staff, costs can also be saved. The training can be carried out independently of time and place, the training organisation facilitated, and the environment additionally relieved. Overall, more efficient emergency training can minimise or prevent risks from fire, material and personal damage, as well as better ensure patient safety.

Keywords: smart solutions for health care, innovation, virtual reality, fire emergency in the operating room, operating theatre staff, simulation, technology, emergency skills

6.1 Introduction

Globally progressing digitalization is also affecting the health sector. The advancement of digitalization is considered a central prerequisite for successful further development in the healthcare sector. Most western healthcare systems are facing the same challenges, for example due to the effects of demographic change and the lack of skilled staff. Digital technologies and services can help to cope better with these challenges and are therefore increasingly being used in healthcare. Smart solutions and the use of digital technologies can help optimize processes in the healthcare sector and improve their effectiveness and efficiency with the aim of improving medical and social services – and thus healthcare provision (E-Health – Digitalisierung im Gesundheitswesen 2021).

One possible innovative technology that is also used in healthcare is Virtual Reality technology (VR-technology). Virtual reality (VR) is now a widespread and ubiquitous technology applied in many variants across sectors. In addition to the fields of communication and entertainment, VR also has great potential in education, research, science, medicine and therapy (Hammer 2016). Recently, more and more companies are creating virtual environments and are using immersive visual technologies, which are the future and consist of virtual reality (Saghafian, Laumann, Akhtar & Skogstad 2020). VR simulations are already being used in the training of pilots, astronauts and train drivers. In the field of medicine, the application spectrum of VR is just as multifaceted. For example, phobias and anxiety disorders can be treated with the help of the technology. Today, VR-assisted medical diagnostics, tele-medicine and training of surgical techniques are widely implemented (Hammer 2016).

VR is characterized by its special hardware and software for creating an artificial reality (Hammer 2016). An artificial three-dimensional environment can be simulated that is very similar to reality (Saghafian et al. 2020). By displaying artificially generated images, the impression of being "present" in virtual reality is given (Hammer 2016). Because VR is particularly applicable for simulating situations and environments difficult to re-enact in reality, it is also ideally suitable for emergency situations in hospitals (Saghafian et al. 2020).

The so-called serious games recently have also become more widespread. These are the use of technologies based on video games for teaching and learning. Serious games serve not only to entertain, but also to educate about situations which are difficult to recreate in the real world due to safety concerns and lack of time and resources (Saghafian et al. 2020, 4).

The module "Innovation project - smart solutions for the development and management of well-being services" is part of the master's program "Digital Healthcare Management". The goal of the module is to develop and elaborate a digital innovation in the field of healthcare or healthcare services within a project work in small groups (Degree Programme in Management of Health and Social Care 90 cr 2021). The results are presented in this scientific article.

The article shows the existing problems and weaknesses in the implementation of traditional emergency training in hospitals. It also points out that especially in the operating theatre, there are numerous sources of danger that can cause a fire (Gehring & Rackebrant 2017, 303). Therefore, effective fire safety training is necessary, especially for this setting and the staff, which, however, does not yet exist in this form either in Germany or in Finland.

The aim of this article is to develop digital solutions for the training of emergency and fire safety activities. Digitalization makes it possible to conduct training in a new dimension. New types of training and new possibilities for reenacting emergency situations are fast emerging.

With the VR technology thematized in the article, emergency situations that cannot be realized in reality can be created as a virtual emergency situation. Consequently, the article shows how the emergency skills of staff in the field of fire safety and patient safety can be improved.

The purpose of this article is to describe the evolution of the VR emergency simulator from an innovation to a prototype. It will be shown how the VR emergency training app described in the article can solve the existing problems of conventional emergency training. Firstly, the aim and purpose of the innovation is described. Then the methods used for the innovation development are shown. The results show how the innovation can be used, visualize the prototype and possible emergency simulations. This is followed by the evaluation of the interviews. At the end of the article, the discussion and conclusion again illustrate how the VR emergency Training app can be a possible innovative digital solution to improve emergency training in hospitals and the emergency skills of the staff.

6.2 Background of the idea and research question

Fire is considered the greatest hazard in hospitals due to the enormous risk to the health and lives of patients and staff, as well as the high expectation of damage in the event of a fire (Defensio Ignis 2022). Especially in an operating room, a fire is not uncommon. Internationally, but also in

Finland and Germany, there have been repeated reports of fires in the operating room, in which the patient undergoing surgery catches fire. The main risk in the operating theatre is the triangle "oxidation - ignition energy - flammable material" (Gehring & Rackebrant 2017, 303).

In this context, the open administration of oxygen to patients under sedation and the use of electrocoagulation are the biggest risk of causing a fire in the operating theatre. Procedures within or near the airways using laser energy are also associated with a high risk. Fire and explosion in the operating theatre are always associated with severe personal and material damage. With the necessary knowledge, good protective measures, efficient training and prevention strategy, these events are basically avoidable despite the increasing use of laser and diathermy technology. (Gehring & Rackebrant 2017, 303.) While the risk of fire in nursing areas of hospitals has been decreasing due to general smoking bans, the risk of fire in operating theatres increases due to possible technical defects caused by the high and further increasing number of electrical devices running in stand-by mode around the clock. Whereas patients on the wards can usually seek shelter or can be quickly transported away by the nursing staff, the anaesthetized patient in the operating theatre is helplessly exposed to all dangers (Noch mehr erfahren? Hier kommen Experten zum Wort... 2022).

Other escape safety challenges include the fact that patients are dependent on vital signs support during surgery and that open wounds cannot be attended to. There is no question that all staff in an operating theatre need to know what to do in an emergency. This requires regular training (Defensio Ignis 2022). Unfortunately, fire protection in medical facilities is not always taken seriously. Apart from deficiencies in the structural basis, the staff is not or only insufficiently trained. Mostly, the training consists of passive concepts with films and questionnaires. For various reasons, not all staff members can participate in the training (Defensio Ignis 2022).

Up to now, there have been large training courses in cooperation with the rescue service. These require the simultaneous participation of the entire staff, which limits the performance of operations at that time. Therefore, such exercises take place rarely and irregularly, because they limit the work in the hospital. Furthermore, there are currently no standardized nationwide regulations for fire protection in hospitals. The minimum requirements for fire protection are usually defined at the state level. Unfortunately, for cost reasons, fire protection concepts are usually only designed to meet these minimum standards (Gehring & Rackebrant 2017, 303). As a result, human lives have repeatedly been lost in hospital fires (Defensio Ignis, 2022). Against this background, the question arises as to how fire safety training in hospitals can be improved. The innovation described in the following is the solution.

6.3 Aim and purpose of the innovation

The aim of the present innovation is to develop an improved fire safety training for hospitals by using digital technology. In addition, the innovation is specifically geared towards the operating theatre. This closes a gap in the market that has existed until now. The VR emergency training app is designed to enable hospitals to provide more effective, less expensive, time and location independent, easy to use, digitally driven, exciting and contemporary innovative emergency training for operating theatre staff that is easily accessible to all staff.

The main idea of the innovation is to improve the emergency skills of the OR staff through a digitally controlled VR training. Existing fire safety trainings are mainly passive methods, consisting of presentations, learning videos, possibly questionnaires, and only a small practical part (Schulung und Brandschutz Training 2019). In contrast, VR emergency training can achieve significantly better learning effects due to the VR method – as an active method. Users become participants in these learning environments, which enables the development of explorative learning (Checa & Bustillo 2019, 5501).

The new visual devices offer the user a unique three-dimensional viewing experience. The virtual environment is very close to reality and is not feasible with conventional methods using screens. A Virtual Reality allows users to learn and experience in a synthetic, computer-generated environment under realistic, yet controlled conditions. Ideally, users perceive the same stimuli in the virtual environment as in reality. The user can interact with the system as in reality. In this way, a special learning environment and a natural interaction are created and combined with a high degree of reality (Alexander, Conradi & Westhove 2017, 1-6) so that the user is immersed in a different environment – in this case is placed in an emergency in the operating theatre. In the process, everything around the user disappears from their field of vision. Virtual reality thus promotes learning as a situational process, which is the great advantage over the conventional method (Zender, Weise, Heyde & Söbke 2018, 1-9).

These virtual emergency situations require quick necessary actions and reactions and force staff to make decisions according to the situation. They are exposed to special stress and extreme situations, as in a real emergency and actively experience dangerous situations and do not have time to think about their actions. Participants are trained to remain calm in these extreme situations and to act quickly, efficiently and correctly. Incorrect actions and their consequences are experienced directly. This direct and timely presentation of the consequences of one's own ac-

tions also supports the learner's self-reflection (Alexander et al. 2017, 1-6). Overall, a higher effectiveness of the training is achieved with an improved internalization of what has been learned and a better expanded long-term knowledge. Based on this, the user can transfer what has been learned to other contexts and later to apply it (Voelker, Maier, Lengenfelder, Schöbel, Petersen, Bonz & Ertlherz 2011). According to the findings of Saghafian et al. (2020), VR-based safety training was demonstrated to be more effective compared to conventional training, as evidenced by, among other things, a reduction in errors and injuries. Virtual reality is considered to have a high potential to improve teaching and learning and to realize novel teaching and training scenarios. This has already been confirmed in several VR learning scenarios, for example for the action skills acquired at the (psycho)motor level (Zender et al. 2018, 1-9).

The purpose of the innovation is to reduce or minimize the risk of material and, above all, personnel damage to the hospital through the improved emergency skills of the staff. The digital method also saves training costs. The app considers the special sources of danger and conditions in an operating theatre and the dangers during different operations. In contrast to a fire in an office, in an operating theatre the helpless patient undergoing surgery needs protection. The staff can learn to act correctly in these stressful situations and care for the patient in an appropriate sequence. In contrast to conventional training, the advantages of VR training mentioned above make them better prepared for a real emergency. In addition, VR-based simulations provide a safe space to perform exercises that would be risky and costly in real life (Checa & Bustillo 2019, 5502).

Another advantage and purpose of the innovation is the simple handling. The virtual reality glasses can access apps and enjoy existing content in the special view. No other technical devices are necessary (Voelker et al. 2011, 431). Moreover, such a game training with the VR technology is always exciting for the staff and increases concentration during a training session. In addition, the novelty of these VR technologies makes it possible to arouse technology-related interest even in people who are less tech-savvy (Zender et al. 2018, 1-9).

The possibility of a team training also promotes cooperation and the right behavior, reaction, and distribution of tasks in coordination with other staff members. VR emergency training is a cost-effective and time-saving solution to achieve this aim: travel costs for the participants and the trainer can be saved. A further advantage is the possibility of an unlimited use of the training, which can be repeated by any staff member at any time if desired. Compared to conventional training, which is almost impossible for all staff members to attend together at specific days and times because of the different shift work schedules, VR training does not result in a loss of staff

at the hospital, as they do not all have to gather for the occasion. Furthermore, hospitals' time resources for training and development have been significantly reduced due to staff shortages and increasing workload (Voelker et al. 2011, 430-431). The VR emergency training app offers a solution to this dilemma. This can be carried out independently of time and location. Thus, staff have ubiquitous training possibilities as credited overtime outside their working shifts on site at the hospital as well as from home.

6.4 Method

The innovation project took place as part of the cooperation between the University of Applied Sciences Neu-Ulm and the Kajaani University of Applied Sciences from 29-10-2021 to 30-05-2021. Students of the Master of Digital Healthcare Management and the Master of Health Care worked together over two semesters on projects related to smart solutions in health care. The multidisciplinary teams were drawn at the beginning and consisted of two or three German students and at least one Finnish student. Except for a few joint appointments with the lecturers, the team members organized themselves independently. During the international week in Finland in February and the international week in Germany in May, additional workshops took place in which the teams worked intensively on the further development of the projects. Furthermore, the teams received new ideas and suggestions through further events and lectures, which could be used for the projects. The initial idea of the innovation was developed by the Finnish students during their professional activities (mainly as nurses). With this direct practical reference, this initial idea served as the basis for the project work.

Project planning and management were taken over by the German students. They defined communication tools, work packages and milestones and drew up the time and content planning for the project. In the multidisciplinary team, the innovation idea was further developed over the entire period from both a technical and an economic perspective. The project was carried out according to the approaches and methods of project management. The basis for innovation development is literature research on possible technical and digital solutions. Methods from the field of "design thinking" were also used to concretize the innovation. This is a systematic procedure for the creation of needs-oriented innovations and complex problem solutions and enables new perspectives for the innovation development (Plattner, Meinel & Leifer 2016, 310-314).

To work out the concrete aim and purpose of the innovation, the qualitative research method was used in the context of the project "VR emergency training app". The method was well suited for the project to gain new insights into the topic and to understand the motives of the people studied for holding a certain opinion on the corresponding topic. For this purpose, qualitative interviews were conducted in the OR in Kainuu Central Hospital in Finland. For doing this, the participants agreed to a consent form. At the beginning of the project, two nurses, one physician and one senior physician were interviewed to work out opinions, attitudes and motives on the topic. In this way, new aspects and other views could be developed. Based on this, the innovation could be further improved and optimized. At the end of the project, three more nurses, one assistant physician and one resident were interviewed to evaluate the prototype of the "VR emergency app". Based on the results, the prototype can be further improved and adapted in future and the innovation can be made more specific (Qualitative Forschung – Die wichtigsten Forschungsmethoden, Merkmale und Vorteile im Überblick 2022). The methods used to collect and analyze the evaluation data are not of great importance from the point of view of using the evaluation data (Pakkanen 2016, 21, 23).

After identifying the problems to be solved and suitable approaches for doing so, the creation of a prototype is very helpful for the evaluation of these solutions by means of interviews (Stackowiak & Kelly 2020, 93). The prototype can be seen as a first attempt, which will later be developed step by step into fully-fledged production-level solutions. The Figma program was used to display the prototype (Nothing great is made alone 2022).

6.5 Results

How to use the innovation

The developed solution includes annual maintenance and updating of the software. A light version of the app can be downloaded from the app store by any employee. This contains all functions without simulation training. The full version with the integrated emergency training is installed on the hospital's own smartphones that can be used for training.

The use case diagram in the illustration depicted below serves as a clear description of the innovation and as the initial programming basis of the innovative software program. It shows the most important functions and goals of the system in a simple and clear fashion. It also illustrates which

use cases are to be considered during development. The objects involved in the system are structured and placed in relation to each other. The requirements for a system can then be derived and specified from this (Web-Entwicklung 2020).

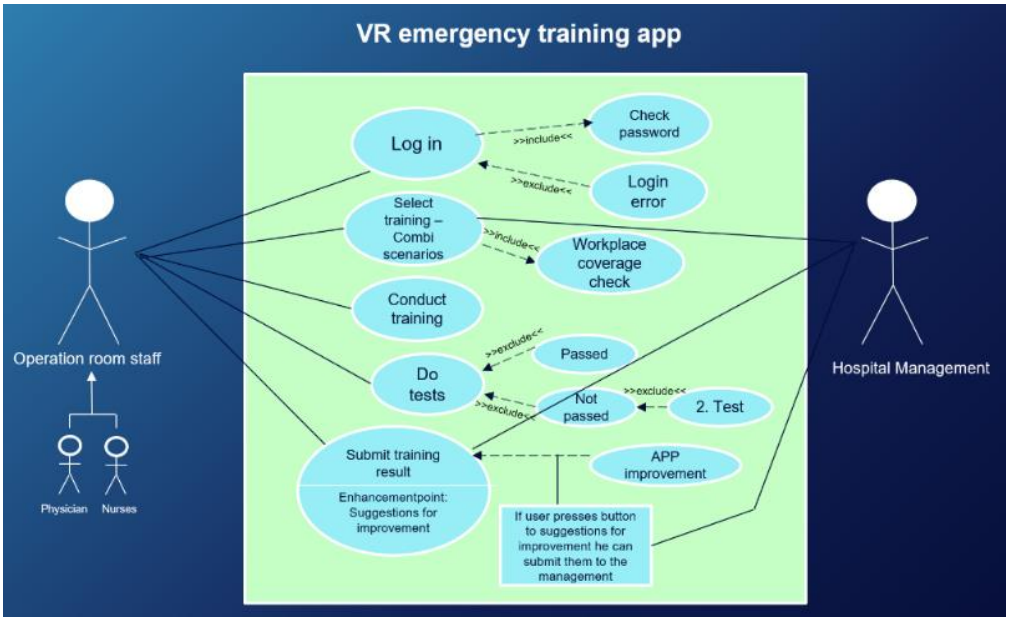

Figure 1. Use case diagram

There are standardized building blocks and three essential elements for the representation of a use case diagram: The system (green box), the actors and the use cases (ellipses) (Web-Entwicklung 2020). On the left side, the main actor is shown with his executive function. This is the user of the app, i.e., the operating theatre staff. On the right side is the secondary actor – the hospital management – with a reactive function. Both actors use the app and have at least one use case [2]. The use case diagram now represents the relationship between an actor and his requirements or expectations of the system.

The connections are described by so-called (include and exclude) associations (Web-Entwicklung 2020). An include association is shown in figure 1, at the “log in”. The password is always checked automatically. In this manner, one use case is consistently executed in unison with the other. The exclude association describes that only under the condition of the users entering an incorrect password, the “log in” fails. At the second use case, the user selects the emergency training, whereby the system automatically checks which training is suitable for the member of staff. The other use cases are shown in the form of ellipses in the diagram and are further illustrated in the process model Figure 2.

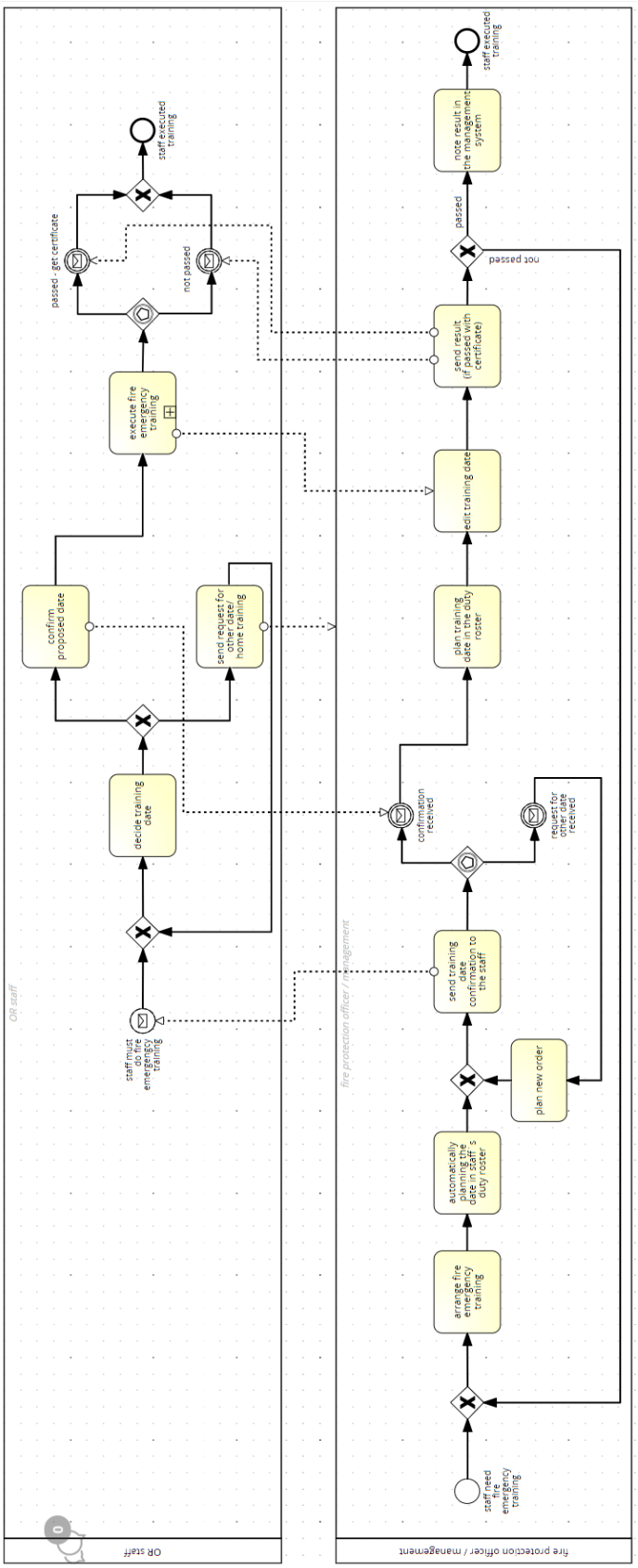

Figure 2. BPMN modelled process

Figure 2 shows the entire process. The process involves both the operating theatre personnel and the hospital management with the fire safety officer and the staff responsible for duty scheduling. The operating theatre staff and the hospital management each have their own process, the execution of which, however, depends on the reactions of the others. The communication between the process participants and the connection of the two sub-processes creates an overall process.

The process starts with the planning of fire safety training by the management at the beginning of each year. Each OR staff member must attend four individual trainings and one team training per year. The dates are planned according to the staff's duty roster. The staff member receives a message about the appointment via their Outlook account with a reference to the corresponding training (different operating rooms) and instructions on how to carry out the training with the VR glasses and how to use the app. The OR staff confirms this appointment or sends a proposal for an alternative appointment, which in turn must be confirmed again by management. After confirmation by both sides, the appointment is firmly scheduled and the OR staff carry out the training on the planned date and in the corresponding room. Depending on whether the staff have successfully completed the training or not, they receive a message from management with the certificate or the message that the training must be repeated. In the latter case, the process starts all over again and the new training date is scheduled.

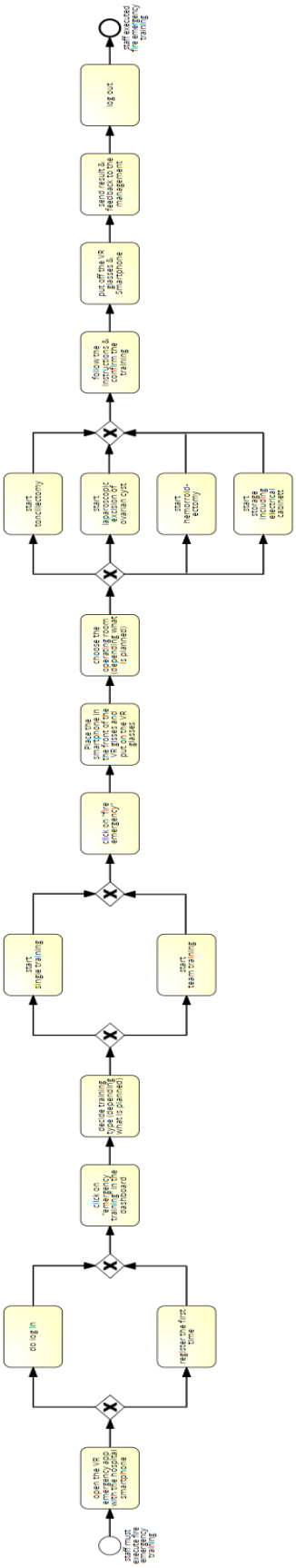

Figure 3. BPMN modelled subprocess of using the VR emergency training app to execute the VR emergency training

Figure 3 depicts the sub-process "execute fire emergency training". The staff carry out the training, which takes approximately 30 minutes, in the designated room in the hospital or at home. The necessary equipment is available in the room, i.e., the VR glasses and the hospital's own smartphones with the full version of the app. If the training is performed at home, the equipment may be taken home. In this case, the training time also counts as working time.

After reading the instructions in the management confirmation email, the OR staff opens the app, performs the “log in” or registers the first time and agrees to the privacy policy. In the dashboard, they select the emergency training and, depending on what has been scheduled for that date, the single or team training. Subsequently, they select the fire emergency training, place the smartphone in the glasses and put the glasses on. The OR staff is then guided through the game. They must follow certain instructions, solve tasks and react and act appropriately in the respective situations. At the end of the training, the employee removes the glasses and takes the smartphone out of the glasses. He receives his score and sends the result to the management. Suggestions for improvement, comments or general feedback can also be sent. Thus, the training can be continuously perfected. For these functions, the app is connected to the hospital's internal system via interoperable interfaces. The certificate is also sent to the user through this connection. By logging out, they finish the training.

Technical components

The heart of modern VR hardware is the VR glasses. Currently on the market, there are many different types of VR glasses from different suppliers. A basic distinction is made between the following classes of VR devices (Hammer 2016): 1. mobile headsets such as Google Daydream 2. high-end headsets such as Oculus Rift.

For the innovation, a technology for VR glasses is utilized that is not only uncomplicated for users to operate but is also inexpensive with sufficiently good quality. For the start and within the framework of the test phase, the mobile headset "Google Daydream" will initially be chosen as a less expensive variant. These glasses are connected directly to a smartphone on which the app for the training is installed. No separate device is necessary. Another advantage for better practicability is that the glasses are wireless. This means that the user's freedom of movement is not restricted. The accompanying controller offers a control function that the user can operate in the game if necessary (Vielhaber 2020). The VR hardware can be used as follows: the smartphone is placed in front of the lenses of the headset and clamped between the frame and the headset. It

is fixed at the top with a short rubber band. In our test, the smartphones remained stable and did not slip. The small, accompanying remote control can simply be connected to the smartphone via Bluetooth (Enge 2017).

Description of the Innovation and Prototype

The first prototype of the app supports the analysis of technical difficulties, their recognition and advance reaction. The prototype also ascertains whether the functions correspond to the needs of the customers. The prototype is the result of various preliminary considerations. It serves to refine the idea and as a presentation for customers and employees, so that the vision and the product can be seen in front of their eyes and can thus be better imagined (Goldner & Graf 2022).

Figure 4 shows the start screen of the prototype including the self-created logo when opening the app. After the successful "log in", the dashboard with the various menu items is displayed (Figure 5).

Figure 4. Start screen of the prototype

Figure 5. Dashboard of the prototype

Here the OR staff can choose between training an emergency, viewing the training history, looking up further information, changing settings or contacting the hospital management. The "Info" button provides information about possible risks when using the VR goggles, displays the data protection regulations and information about fire emergencies in the OR. With the menu button in the upper left corner, the user can return to the dashboard at any time. Under “Settings”, general settings such as audio, app, display and connection settings can be changed. The desired language or some advanced functions can also be adjusted. The section "training history" displays an overview of the completed trainings. The icon indicates the type of training (e.g., fire, single or team training.). It is also possible to download and print the certificate. By clicking on the image

in the upper right corner, the OR staff can access their own profile where they can change and edit their data. To conduct the emergency training, team and individual training can be selected or different emergency situations such as a fire, a rampage, a gas emergency or an earthquake. However, the present innovation is initially limited to fire safety training in the operating theatre, as outlined earlier. After the appropriately planned training has been selected, brief instructions are given on how to use the VR goggles. The app starts the training game, which is performed with the VR glasses.

Figure 6 shows the view through the VR glasses during the training game. The app includes several trainings with different scenarios, emergency situations and operation types. According to preference, users can select an operating theatre (toncillectomy, laparoscopic excision of ovarian cyst, hemorrhoidectomy, storage including electrical cabinet).

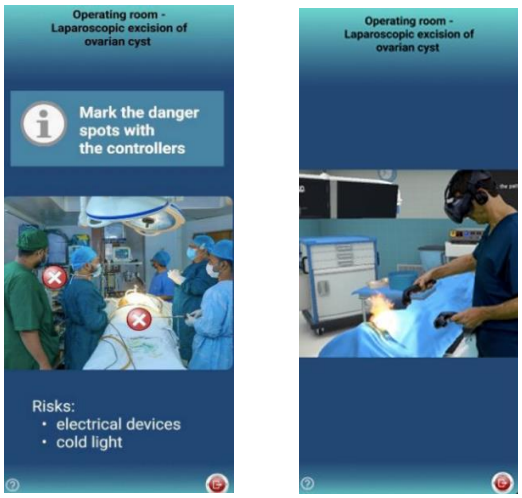

Figure 6. Simulated view of the training game

With the help of virtual glasses, they then find themselves in the operating theatre and can visualize and see themselves in the room of the fire emergency. The first task is to identify the risk factors for a fire in the room, which they can correctly locate and mark. As soon as a fire occurs, they have to perform their individually chosen actions they deem suitable for the situation. In this way, they can learn the correct actions. For example, when operating with an endoscope light, they must handle it carefully and keep it away from flammable materials, because the cold light can ignite it. In a simulated fire situation, a fire could have started on the blanket of the unconscious and intubated patient. In this situation, users should call for help, stay calm and protect themselves. The next correct step is for them to remove the covers, turn off the light of the endoscope and store it safely. Two situations can be simulated: In the first case, the fire is large. Here, the OR staff must take the fire extinguisher to put out the fire. In the second case, if the fire is small, they can control it either with the fire extinguisher or with a fire blanket (figure 6). In the

next step, they have to take care of the patient and prepare him for evacuation. At the end, they receive their points depending on how many times they acted and reacted correctly. This concludes the training. Furthermore, team training is possible. In this exercise model, they can train and learn communication and team skills. For this purpose, a leader must always be designated who assigns certain tasks to the other staff members.

Evaluation of the interviews

The aim of the first qualitative interviews at the beginning of the project was to work out opinions, attitudes and motives on the topic. In addition, it was possible to check whether the initial assumptions about the research question could be confirmed so that the aim and purpose of the innovation could be made clearer. The following table shows the responses of the initial interviewees.

Table 1. Interviews with two nurses and one physician

Information about a fire emergency and risk factors in OR	**Firefighting exercises**	**Experience with VR glasses**	**Wishes**
• Ok, prepared for fire emergencies • Not bad, moderate information • Not so high	• Once a year they have a safety walk and training in fire department, it was most of the time outdoors and cold • Safety walks often and many times in fire department, sometimes just repeating theory • He didn't have any, he is not prepared	• No, she rather learns with simulations • Just once with a roller-coaster simulator, it could be interesting for her • No, He would like to train with VR glasses	• As often as now, practicing with simulations that they can't have that situation in reality • Once a year, using simulations • Have training for every employee, Practice in free time

A noteworthy point in the survey responses is that the physician had never practiced firefighting. That is the main reason why nurses rated their skills higher that the physician.

Table 2. Interview with the senior physician of the OR

Risk of an emergency in the hospital / how high is the rate of the competence of hospital staff in a fire emergency	**Firefighting exercises, fire experiences**	**What groups of the staff should specifically do fire safety training?**	**Wishes**
• Moderate / Moderate-Good	• Once a year, fire extinguishers and fire exit, just one fire in 20 years	• Most important Groups are Nurses	• Fire trainings twice a year, • costs/effect → 30/70

Overall, the results of the interviews show that the initial assumptions were confirmed. Thus, OR staff need more sufficient training for (fire) emergency situations to be better prepared and more

confident, especially due to the special circumstances. Training should be more cost effective and more accessible to all staff. Furthermore, training with VR is more attractive and effective for the OR staff. These findings enabled the development and design of a prototype.

The aim of the second interviews was to evaluate the prototype of the VR emergency app and to analyse if the app has the features that users want to meet their needs. All the interviewed persons looked at the app by themselves. The interviews were conducted afterwards. The most important answers that emerged from the interviews with potential users are shown in the following table.

Table 3. Second interview with three nurses, one assistant ward nurse and one resident

Design	**Menu navigation**	**Functionality**	**Absence of any functions**	**Imagining such a training**	**Advantages/disadvantages, increased/decreased and benefits/efficiencies in this type of training compared to the traditional ones**
easy simple nice coloring	clear logical simple easy to use	won't take too much time clear and logical won't replace practical training	Back-button Sounds	Absolutely Yes Not really as an only training method	training alone is easier for introverts could be used as a support for lectures reaches more staff

Overall, the responses were mostly positive. Some doubts arose partly from lack of experience with VR and partly from having a lot of experience with VR. Respondents without experience were uncertain what to expect. However, those with a lot of experience are more sceptic and cannot be easily convinced of the technical execution, quality and simulation. The following lessons can be learned for the further development of the prototype. To develop a visually impressive simulator, various resources such as funding and staff with good IT knowledge and appropriate skills are needed.

6.6 Discussion and conclusion

Consequently, it is clear from the article that VR emergency training with new digital technology can solve the problems of conventional emergency training outlined in this paper. It can improve the emergency skills of OR staff. Compared to conventional methods, VR has the great advantage of creating realistic environments and simulations in an emergency, which cannot be implemented in real-life exercises due to safety concerns and lack of time and resources. Staff in the

operating theatre actively experience realistic, extreme and stressful situations and must make quick decisions appropriate to the situation and react and act accordingly (Hammer 2016).

Findings from other fields show that learning effects in various forms of training can be improved by immersion in this virtual reality. For example, pilots can learn hovering and other basic maneuvers, as well as practice various emergency procedures such as autorotation with landing and tail rotor failure. With the simulation, situations can thus be carried out that would be too dangerous. Overall, the safety of pilot training can be increased, and training missions can be carried out regardless of the weather (Virtuelle Realität soll beim Flugtraining helfen 2021). Because of its advantages, VR is also used in many ways in the field of medicine, especially for the training of medical staff. For example, internal processes of the human body can be vividly depicted. In virtual reality, students cannot only see the organs and tissue parts, but also interact with them in a completely new way, while not compromising patient safety (Hammer 2016).

Further study results have shown the effectiveness of VR training as an effective alternative to traditional training methods. Training using serious games and VR show more effective training outcomes compared to traditional methods, in terms of safety knowledge acquisition and memory retention. In addition to the benefits of VR training and its effectiveness, these technologies help to reduce training time and infrastructure, while lowering operational costs, reducing labor costs and increasing productivity. (Saghafian et al. 2020; Mäkelä & Mäkijärvi 2012.)

These presented findings allow a transfer to the innovation described in the article. Therefore, the same effects can be assumed for fire safety training in the operating theatre with VR technology. VR emergency training thus improves the emergency skills of operating theatre staff through greater knowledge retention, much better internalization and improved perception of hazards in an emergency. The use of digital technology thus increases the efficiency of training (Saghafian et al. 2020).

Study results, as well as the interviews conducted in the project, show that most of the people interviewed rated the VR training itself (Saghafian et al. 2020). Through the interviews, the positive evaluation of the prototype, among other things, clearly confirmed the acceptance for the iInnovation of VR emergency training and for emergency training with VR technology in general. Nevertheless, it should be noted that study results as well as the interviews showed that training in the virtual environment is partly only accepted as a supplement to conventional training (Saghafian et al. 2020). Thus, further intensive persuasion work is necessary for the future, possibly through an improved presentation of the concept.

Moreover, health risks must not be ignored. According to study results, 90 percent of the test persons felt no symptoms of simulation sickness when testing a VR training. Most of the respondents said they experienced positive feelings like ”feeling excited,” “becoming engaged,” feeling “comfortable”. However, for a little percentage of people, there are risks of nausea during, as well as dizziness and discomfort after the training (Saghafian et al. 2020; Emenike 2017).

In conclusion, it can be said that the fusion of game-based approaches and virtual reality environments, which can enhance learning and education methods has a promising future. This is reinforced by the wide market availability of affordable software and hardware tools for VR technology (Checa & Bustillo 2019, 5501-5502). Moreover, the innovation can be expanded in many ways due to its good scalability. On the one hand, this allows an expansion of the types of emergencies beyond fire. For example, simulation training for an emergency caused by an earthquake, a rampage or a gas explosion is also possible. On the other hand, the good scalability of the innovation idea makes it easy to implement in other occupational groups and work settings.

With the development of the concept completed and the technical feasibility checked, the realization of the project is entirely possible. For the practical implementation of the project, experts such as programmers and fire safety officers are needed. In addition, professional cooperation between programmers, OR staff and fire safety experts is necessary for the implementation of high-quality professional and technically convincing training.

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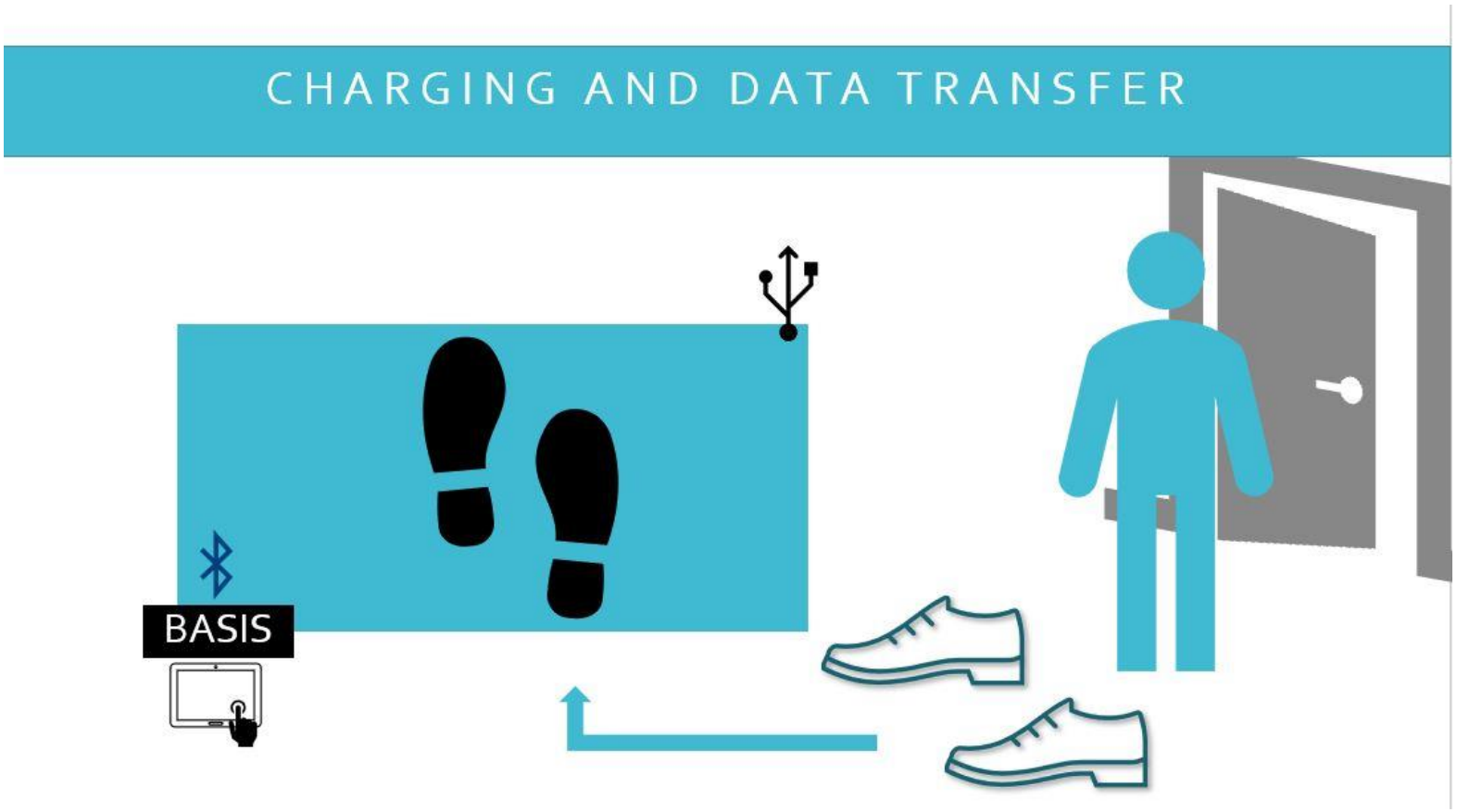
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